START

008066

216-B-63 TRENCH
April 1987
REV 0

216-B-63 Trench Preliminary Closure/Post-Closure Plan

FOREWORD

The U.S. Department of Energy - Richland Operations Office (DOE-RL) Part B Permit Application for the Hanford Site consists of separate permit applications for the following hazardous waste treatment, storage, and disposal units:

1. The Nonradioactive Dangerous Waste Landfill and storage facilities
2. Alkali metal treatment and storage facilities
3. Low-level burial grounds and retrievable storage
4. 1324-N surface impoundment
5. 1706-KE waste treatment system.

The following facilities are known to have received hazardous waste but will continue to operate, receiving only nonregulated waste as described in separate closure/post-closure plans:

1. 216-B-3 pond
2. 216-A-29 ditch
3. 216-B-63 trench
4. 2101-M pond
5. 100-D ponds
6. 1324-NA percolation pond (closure plan only).
7. 300 Area process trenches.

In addition, the following hazardous waste treatment, storage, and disposal units will be closed under interim status and have been described in a closure/post-closure plan:

1. Solar evaporation basins
2. Solvent evaporator (closure plan only)
3. 1301-N Liquid Waste Disposal Facility.

Each separate permit application and closure/post-closure plan provides a complete description of hazardous waste management activities as is required in Washington Administrative Code (WAC) Chapter 173-303-806, Title 40, Code of Federal Regulations, Part 270, Subpart B, and WAC 173-303-400 (40 CFR 265, Subpart G), respectively.* It is anticipated that each separate Part B Permit Application or closure/post-closure plan will be reviewed individually and will undergo subsequent revisions prior to acceptance by the Washington State Department of Ecology or the U.S. Environmental Protection Agency (EPA), Region X.

The following submittal contains the DOE-RL Closure/Post-Closure Plan for the 216-B-63 trench.

*At the time this document was prepared, the EPA had not authorized the State of Washington to regulate radioactive mixed wastes under the Resource Conservation and Recovery Act. In a July 3, 1986, Federal Register notice (51 FR 24504), the EPA indicated that currently authorized state programs do not apply to radioactive mixed wastes. Neither the EPA nor the State of Washington have regulations specifically addressing these wastes and it is uncertain how such wastes will be regulated. However, since the State of Washington has applied to EPA for authority to regulate radioactive mixed wastes, this plan has been written to existing State regulations on the assumption that the State will be authorized to regulate these wastes before the plan is acted upon. If this expectation does not occur, or if specific regulations addressing radioactive mixed wastes are adopted, this plan will be amended as necessary.

CONTENTS

Figures:

Tables:

1.0 PART A APPLICATION

1.1 INTRODUCTION

The 216-B-63 trench is an open, unlined trench used for disposal of potentially radioactive (low-risk) waste water from the B Plant chemical sewer. This discharge is composed of nonprocess steam condensate, demineralizer recharge effluents, and compressor cooling water and condensate.

In the past, demineralizer effluents were released sequentially from the anion and cation columns, which caused the effluent to be outside the pH 2.0 to 12.5 limits. Current practice is to divert each effluent to a holding tank where the cation column effluent is neutralized with sodium carbonate and the anion column effluent is neutralized with monosodium phosphate. Once neutralized to a pH of between 4 and 10, the effluents are released to the chemical sewer. Procedural controls also require neutralization of corrosive chemicals before release from storage or makeup tanks and forbid the intentional release of hazardous materials to the chemical sewer.

Volume 2 of the U.S. Department of Energy - Richland Operations Office (DOE-RL) Part A Permit Application was prepared for submittal to the Washington State Department of Ecology (WDOE) and the U.S. Environmental Protection Agency (EPA), Region X, on August 15, 1986. This volume contained waste designation and treatment process information for the DOE-RL 216-B-63 trench located within the perimeter of the 200 East Area of the Hanford Site.

1.2 PART A APPLICATION

The following Part A Application contains waste process and designation codes for the 216-B-63 trench.

PART A

DANGEROUS WASTE PERMIT FORMS

(FORMS 1 AND 3)

FORM 1

State of Washington Department of Ecology

WASHINGTON STATE

DANGEROUS WASTE PERMIT GENERAL INFORMATION

(Read "Form 1 Instructions" before starting)

I. EPA/STATE I.D. NUMBER

W A 7 8 9 0 0 0 8 9 6 7

II. NAME OF FACILITY

US DEPT OF ENERGY RICHLAND OPERATIONS OFFICE

III. FACILITY CONTACT

A. NAME & TITLE (last, first, & title): FITZSIMMONS, T. R. ASSISTANT MGR SAFETY*

B. PHONE (area code & no.): 509 376 7387

IV. FACILITY MAILING ADDRESS

A. STREET OR P.O. BOX: P.O. BOX 550

B. CITY OR TOWN: RICHLAND

C. STATE: WA

D. ZIP CODE: 99352

V. FACILITY LOCATION

A. STREET, ROUTE NO. OR OTHER SPECIFIC IDENTIFIER: HANFORD SITE

B. COUNTY NAME: BENTON

C. CITY OR TOWN: RICHLAND

D. STATE: WA

E. ZIP CODE: 99352

F. COUNTY CODE (if known): 005

IV. SIC CODES (4-digit, in order of priority)

A. FIRST: 9711 (specify) NATIONAL SECURITY

B. SECOND: 8922 (specify) NUCLEAR NONCOMMERCIAL RESEARCH DEVELOPMENT AND EDUCATION

C. THIRD: 9611 (specify) ADMINISTRATION AND GENERAL ECONOMICS PROGRAM

D. FOURTH: 4911 (specify) STEAM - ELECTRIC GENERATOR

VII. OPERATOR INFORMATION

A. NAME: US DEPT OF ENERGY RICHLAND OPERATIONS

B. Is the name listed in Item VII-A also the owner? ☒ YES ☐ NO

C. STATUS OF OPERATOR (Enter the appropriate letter into the answer box; if "Other", specify.)

F = FEDERAL
S = STATE
P = PRIVATE
M = PUBLIC (other than federal or state)
O = OTHER (specify)

F (specify)

D. PHONE (area code & no.): 509 376 7387

E. STREET OR P.O. BOX: PO BOX 550

F. CITY OR TOWN: RICHLAND

G. STATE: WA

H. ZIP CODE: 99352

VIII. INDIAN LAND

Is the facility located on Indian lands? ☐ YES ☒ NO

COMPLETE BACK PAGE

*Office of Assistant Manager for Safety, Safeguards and Quality Assurance

ECY 030-31

ECL 4 -079

WA7890008967

IX. MAP

Attach to this application a topographic map of the area extending to at least one mile beyond property boundaries. The map must show the outline of the facility, the location of each of its existing and proposed intake and discharge structures, each of its hazardous waste treatment, storage, or disposal facilities, and each well where it injects fluids undergound. Include all springs, rivers and other surface water bodies in the map ares. See instructions for precise requirements.

X. NATURE OF BUSINESS *(provide a brief description)*

O NATIONAL DEFENSE NUCLEAR MATERIAL PRODUCTION

O ENERGY RESEARCH AND TECHNOLOGY DEVELOPMENT

O DEFENSE NUCLEAR WASTE MANAGEMENT

O BYPRODUCT STEAM, SOLD FOR ELECTRIC POWER GENERATION

O AND SIC 15: BUILDING CONSTRUCTION - GENERAL CONTRACTORS AND OPERATIVE BUILDERS

XI. CERTIFICATION *(see instructions)*

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this application and all attachments and that, based on my inquiry of those persons immediately responsible for obtaining the information contained in the application, I believe that the information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

A. NAME & OFFICIAL TITLE (type or print)	B. SIGNATURE	C. DATE SIGNED
T.R. FITZSIMMONS, ASST.MANAGER		

ECY 030-31 Reverse

ECL 1 278-

Continued from the front

IV. DESCRIPTION OF DANGEROUS WASTES (continued)

E. USE THIS SPACE TO LIST ADDITIONAL PROCESS CODES FROM SECTION D(1) ON PAGE 3.

V. FACILITY DRAWING Refer to Sections V in the following chapters

All existing facilities must include in the space provided on page 5 a scale drawing of the facility (see instructions for more detail).

VI. PHOTOGRAPHS Refer to Sections VI in the following chapters

All existing facilities must include photographs (aerial or ground—level) that clearly delineate all existing structures; existing storage, treatment and disposal areas; and sites of future storage, treatment or disposal areas (see instructions for more detail).

VII. FACILITY GEOGRAPHIC LOCATION Refer to Sections VI and VII in the following chapters

LATITUDE (degrees, minutes, & seconds)	LONGITUDE (degrees, minutes, & seconds)

VIII. FACILITY OWNER

[X] A. If the facility owner is also the facility operator as listed in Section VII on Form 1, "General Information", place an "X" in the box to the left and skip to Section IX below.

B. If the facility owner is not the facility operator as listed in Section VII on Form 1, complete the following items:

1. NAME OF FACILITY'S LEGAL OWNER	2. PHONE NO. (area code & no.)

3. STREET OR P.O. BOX	4. CITY OR TOWN	5. ST.	6. ZIP CODE

IX. OWNER CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

NAME (print or type)	SIGNATURE	DATE SIGNED
T.R. FITZSIMMONS, ASST. MANAGER		

X. OPERATOR CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

NAME (print or type)	SIGNATURE	DATE SIGNED
T.R. FITZSIMMONS, ASST. MANAGER		

CONTINUE ON PAGE 5

(fill-in areas are spaced for elite type, i.e., 12 characters/inch)

FORM 3

DANGEROUS WASTE PERMIT APPLICATION

I. EPA/STATE I.D. NUMBER: W A 7 8 9 0 0 0 8 9 6 7

FOR OFFICIAL USE ONLY

APPLICATION APPROVED	DATE RECEIVED (mo., day & yr.)	COMMENTS

II. FIRST OR REVISED APPLICATION

Place an "X" in the appropriate box in A or B below (mark one box only) to indicate whether this is the first application you are submitting for your facility or a revised application. If this is your first application and you already know your facility's EPA/STATE I.D. Number, or if this is a revised application, enter your facility's EPA/STATE I.D. Number in Section I above.

A. FIRST APPLICATION (place an "X" below and provide the appropriate date)

[X] 1. EXISTING FACILITY (See instructions for definition of "existing" facility. Complete item below.)

MO. 03 DAY __ YR. 70 — FOR EXISTING FACILITIES, PROVIDE THE DATE (mo., day, & yr.) OPERATION BEGAN OR THE DATE CONSTRUCTION COMMENCED (use the boxes to the left)

[ ] 2. NEW FACILITY (Complete item below.)

MO. __ DAY __ YR. __ — FOR NEW FACILITIES, PROVIDE THE DATE (mo., day, & yr.) OPERATION BEGAN OR IS EXPECTED TO BEGIN

B. REVISED APPLICATION (place an "X" below and complete Section I above)

[ ] 1. FACILITY HAS AN INTERIM STATUS PERMIT

[ ] 2. FACILITY HAS A FINAL PERMIT

III. PROCESSES — CODES AND DESIGN CAPACITIES

A. PROCESS CODE — Enter the code from the list of process codes below that best describes each process to be used at the facility. Ten lines are provided for entering codes. If more lines are needed, enter the code(s) in the space provided. If a process will be used that is not included in the list of codes below, then describe the process (including its design capacity) in the space provided on the (Section III-C).

B. PROCESS DESIGN CAPACITY — For each code entered in column A enter the capacity of the process.
1. AMOUNT — Enter the amount.
2. UNIT OF MEASURE — For each amount entered in column B(1), enter the code from the list of unit measure codes below that describes the unit of measure used. Only the units of measure that are listed below should be used.

PROCESS	PROCESS CODE	APPROPRIATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY
Storage:		
CONTAINER (barrel, drum, etc.)	S01	GALLONS OR LITERS
TANK	S02	GALLONS OR LITERS
WASTE PILE	S03	CUBIC YARDS OR CUBIC METERS
SURFACE IMPOUNDMENT	S04	GALLONS OR LITERS
Disposal:		
INJECTION WELL	D80	GALLONS OR LITERS
LANDFILL	D81	ACRE-FEET (the volume that would cover one acre to a depth of one foot) OR HECTARE-METER
LAND APPLICATION	D82	ACRES OR HECTARES
OCEAN DISPOSAL	D83	GALLONS PER DAY OR LITERS PER DAY
SURFACE IMPOUNDMENT	D84	GALLONS OR LITERS
Treatment:		
TANK	T01	GALLONS PER DAY OR LITERS PER DAY
SURFACE IMPOUNDMENT	T02	GALLONS PER DAY OR LITERS PER DAY
INCINERATOR	T03	TONS PER HOUR OR METRIC TONS PER HOUR, GALLONS PER HOUR OR LITERS PER HOUR
OTHER (Use for physical, chemical, thermal or biological treatment processes not occurring in tanks, surface impoundments or incinerators. Describe the processes in the space provided, Section III-C.)	T04	GALLONS PER DAY OR LITERS PER DAY

UNIT OF MEASURE	UNIT OF MEASURE CODE
GALLONS	G
LITERS	L
CUBIC YARDS	Y
CUBIC METERS	C
GALLONS PER DAY	U
LITERS PER DAY	V
TONS PER HOUR	D
METRIC TONS PER HOUR	W
GALLONS PER HOUR	E
LITERS PER HOUR	H
ACRE-FEET	A
HECTARE-METER	F
ACRES	B
HECTARES	Q

EXAMPLE FOR COMPLETING SECTION III *(shown in line numbers X-1 and X-2 below)*. A facility has two storage tanks, one tank can hold 200 gallons and the other can hold 400 gallons. The facility also has an incinerator that can burn up to 20 gallons per hour.

LINE NUMBER	A. PROCESS CODE (from list above)	B. 1. AMOUNT (specify)	B. 2. UNIT OF MEASURE (enter code)	FOR OFFICIAL USE ONLY
X-1	S02	600	G	
X-2	T03	20	E	
1	T04	5,300	E	
2				
3				
4				
5				
6				
7				
8				
9				
10				

Continued from the front

III. PROCESSES (continued)

C. SPACE FOR ADDITIONAL PROCESS CODES OR FOR DESCRIBING OTHER PROCESS (code "T04"). FOR EACH PROCESS ENTERED HERE INCLUDE DESIGN CAPACITY

T04: The 216-B-63 Trench has historically received waste from the B-Plant Chemical Sewer, comprised primarily of demineralizer recharge effluent. Monitoring of the demineralizer recharge effluent pH revealed in October of 1985 that the demineralizer effluent was outside of the pH 2.0 to 12.5 limits. Actions were taken to provide demineralizer effluent neutralization following identification of the out-of-tolerance pH levels. Acids and bases were discharged to this unit in series. This situation, as well as the large volumes of neutral process wastewaters that were released after acid/base discharge served to rapidly neutralize the corrosive discharges. Any acidic or basic waters that reached the soil were further neutralized by the calcareous nature of the soil.

IV. DESCRIPTION OF DANGEROUS WASTES

A. DANGEROUS WASTE NUMBER — Enter the four digit number from Chapter 173-303 WAC for each listed dangerous waste you will handle. If you handle dangerous wastes which are not listed in Chapter 173-303 WAC, enter the four digit number(s) that describes the characteristics and/or the toxic contaminants of those dangerous wastes.

B. ESTIMATED ANNUAL QUANTITY — For each listed waste entered in column A estimate the quantity of that waste that will be handled on an annual basis. For each characteristic or toxic contaminant entered in column A estimate the total annual quantity of all the non—listed waste(s) that will be handled which possess that characteristic or contaminant.

C. UNIT OF MEASURE — For each quantity entered in column B enter the unit of measure code. Units of measure which must be used and the appropriate codes are:

ENGLISH UNIT OF MEASURE	CODE	METRIC UNIT OF MEASURE	CODE
POUNDS	P	KILOGRAMS	K
TONS	T	METRIC TONS	M

If facility records use any other unit of measure for quantity, the units of measure must be converted into one of the required units of measure taking into account the appropriate density or specific gravity of the waste.

D. PROCESSES

1. PROCESS CODES:

For listed dangerous waste: For each listed dangerous waste entered in column A select the code(s) from the list of process codes contained in Section III to indicate how the waste will be stored, treated, and/or disposed of at the facility.

For non—listed dangerous wastes: For each characteristic or toxic contaminant entered in Column A, select the code(s) from the list of process codes contained in Section III to indicate all the processes that will be used to store, treat, and/or dispose of all the non—listed dangerous wastes that possess that characteristic or toxic contaminant.

Note: Four spaces are provided for entering process codes. If more are needed: (1) Enter the first three as described above; (2) Enter "000" in the extreme right box of Item IV-D(1), and (3) Enter in the space provided on page 4, the line number and the additional code(s).

2. PROCESS DESCRIPTION: If a code is not listed for a process that will be used, describe the process in the space provided on the form.

NOTE: DANGEROUS WASTES DESCRIBED BY MORE THAN ONE DANGEROUS WASTE NUMBER — Dangerous wastes that can be described by more than one Waste Number shall be described on the form as follows:

1. Select one of the Dangerous Waste Numbers and enter it in column A. On the same line complete columns B, C, and D by estimating the total annual quantity of the waste and describing all the processes to be used to treat, store, and/or dispose of the waste.
2. In column A of the next line enter the other Dangerous Waste Number that can be used to describe the waste. In column D(2) on that line enter "included with above" and make no other entries on that line.
3. Repeat step 2 for each other Dangerous Waste Number that can be used to describe the dangerous waste.

EXAMPLE FOR COMPLETING SECTION IV *(shown in line numbers X-1, X-2, X-3, and X-4 below)* — A facility will treat and dispose of an estimated 900 pounds per year of chrome shavings from leather tanning and finishing operation. In addition, the facility will treat and dispose of three non—listed wastes. Two wastes are corrosive only and there will be an estimated 200 pounds per year of each waste. The other waste is corrosive and ignitable and there will be an estimated 100 pounds per year of that waste. Treatment will be in an incinerator and disposal will be in a landfill.

LINE NO.	A. DANGEROUS WASTE NO. *(enter code)*	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE *(enter code)*	D. PROCESSES 1. PROCESS CODES *(enter)*	D. PROCESSES 2. PROCESS DESCRIPTION *(If a code is not entered in D(1))*
X-1	K 0 5 4	900	P	T 0 3 D 8 0	
	D 0 0 2	400	P	T 0 3 D 8 0	
X-3	D 0 0 1	100	P	T 0 3 D 8 0	
X-4	D 0 0 2			T 0 3 D 8 0	*included with above*

CONTINUE ON PAGE 3

Continued from page 2
NOTE Photocopy this page before completing if you have more than 26 wastes to list

ID NUMBER (enter from page 1): W A 7 8 9 0 0 0 8 9 6 7

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

LINE NO.	A. DANGEROUS WASTE NO. (enter code)	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE (enter code)	D. PROCESSES 1. PROCESS CODES (enter)	D. PROCESSES 2. PROCESS DESCRIPTION (if a code is not entered in D(1))
1	D 0 0 2	8,379,000	G	T 0 4	
2		This quantity reflects total discharges to the facility, and not a volume			
3		of designated dangerous wastes. This facility does not currently and will			
4		not in the future receive discharges of regulated dangerous wastes.			
5					
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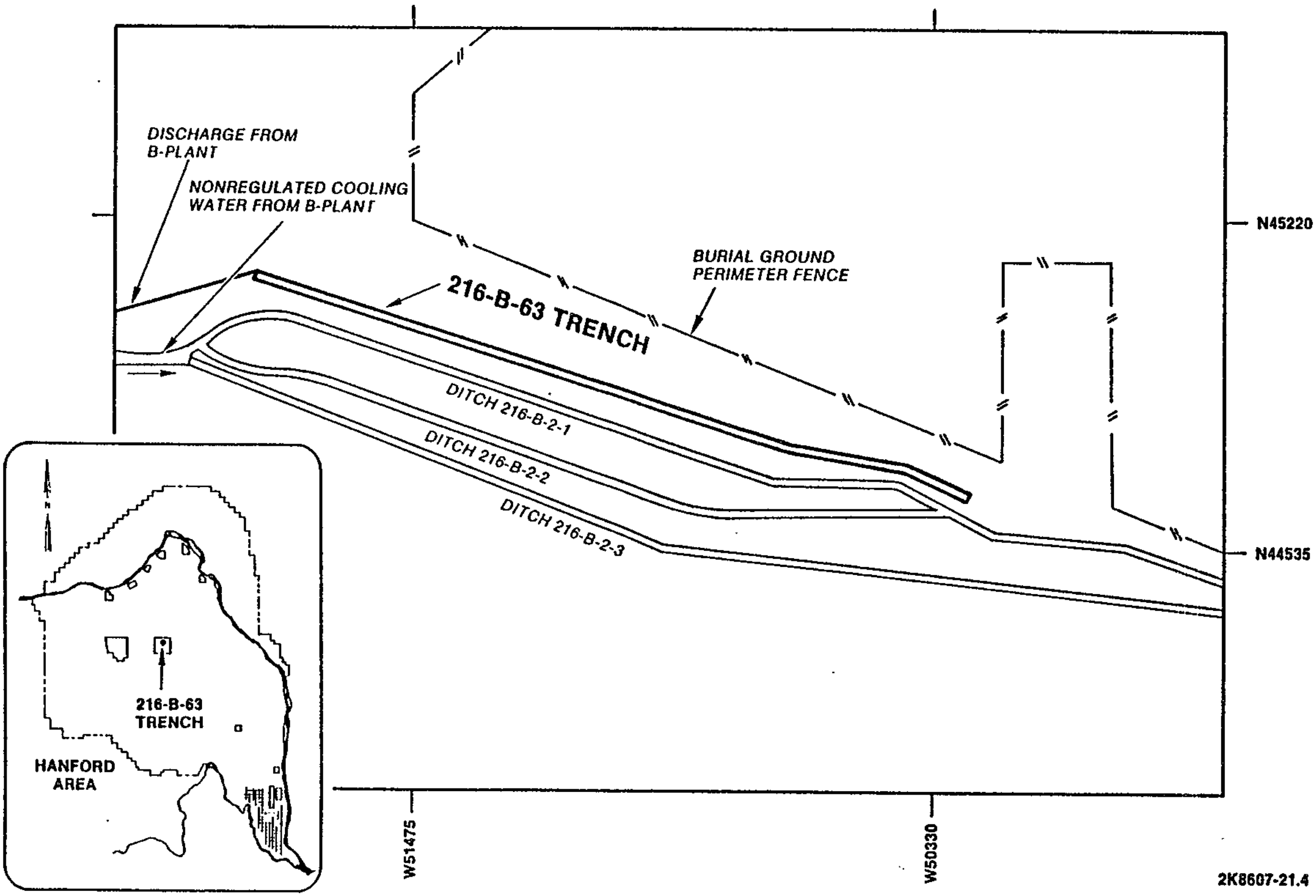
26					

SECTION V - FACILITY DRAWINGS

SECTION VI - PHOTOGRAPHS

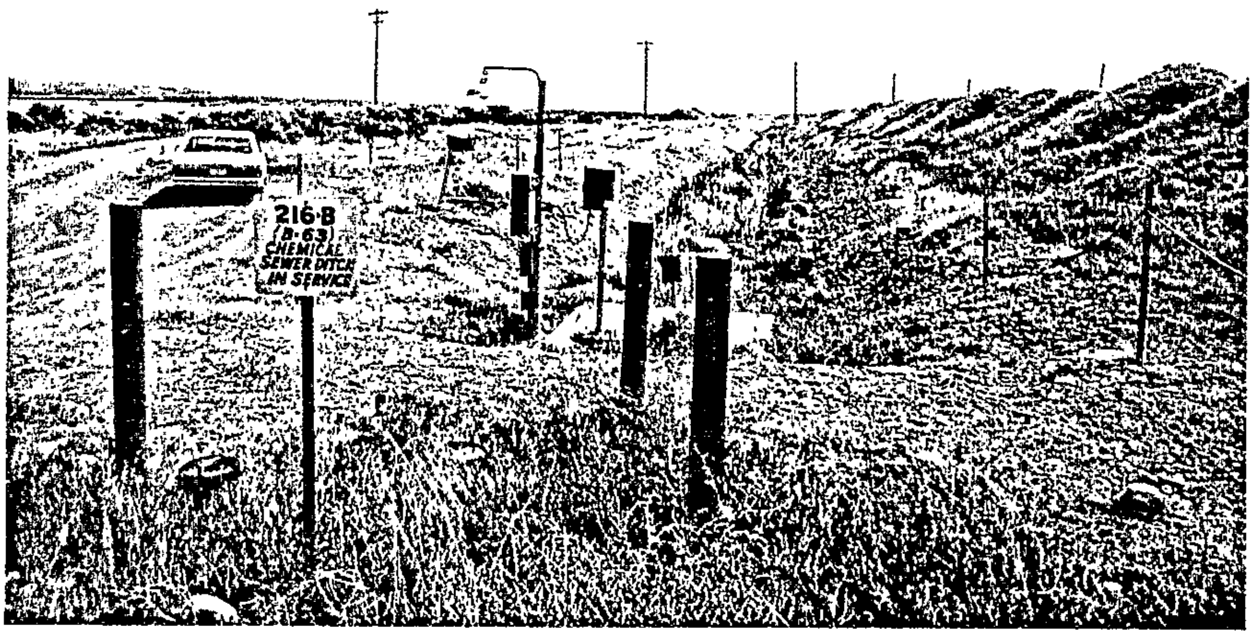
216-B-63 TRENCH



2K8607-21.4

WA7890008967

216-B-63 TRENCH



Latitude	Longitude
46° 33′50.488″	119° 31′56.117″
46° 33′45.651″	119° 31′34.158″

PHOTO TAKEN 1985

2K8607-21.18

2.0 FACILITY DESCRIPTION

This section provides a general description of the hazardous waste management facility discussed in this closure plan, and is intended to provide the permit application reviewer/permit writer with an overview of the facility.

2.1 GENERAL DESCRIPTION

The Hanford Site is a 570-mi^2 (1,476-km^2) tract of semiarid land that is owned and operated by the DOE. This site is located northwest of the city of Richland, Washington, along the Columbia River. The city of Richland lies approximately 3 mi (4.8 km) from the southernmost portion of the Hanford Site boundary and is the nearest population center (fig. 2-1). In early 1943, the U.S. Army Corps of Engineers selected the Hanford Site as the location for reactor, chemical separation, and related facilities for the production and purification of plutonium. A total of eight graphite-moderated reactors using Columbia River water for once-through cooling were built along the Columbia River. These reactors were operated from 1944 to 1971.

N Reactor, a dual-purpose reactor for production of plutonium and generation of steam for production of electricity, uses recirculating water coolant. N Reactor began operating in 1963 and remains in operation today.

Activities are centralized in numerically designated areas on the Hanford Site. The reactor facilities (active and decommissioned) are located along the Columbia River in the 100 Areas. The reactor fuel processing and waste management facilities are located in the 200 Areas, situated on a plateau about 7 mi (11.2 km) from the river. The 300 Area, located north of Richland, contains the reactor fuel manufacturing facilities and the research and development laboratories. The 400 Area, 5 mi (8 km) northwest of the 300 Area, contains the Fast Flux Test Facility. The 1100 Area, north of Richland, contains buildings associated with maintenance and transportation functions for the Hanford Site. Administrative buildings and other research and development laboratories are found in the 3000 Area, also north of Richland. The Nonradioactive Dangerous Waste Landfill is located 2 mi (3.2 km) southeast of the 200 East Area in the 600 Area. The Nonradioactive Dangerous Waste Storage Facility is located between the 200 East and West Areas on Route 3S, also in the 600 Area.

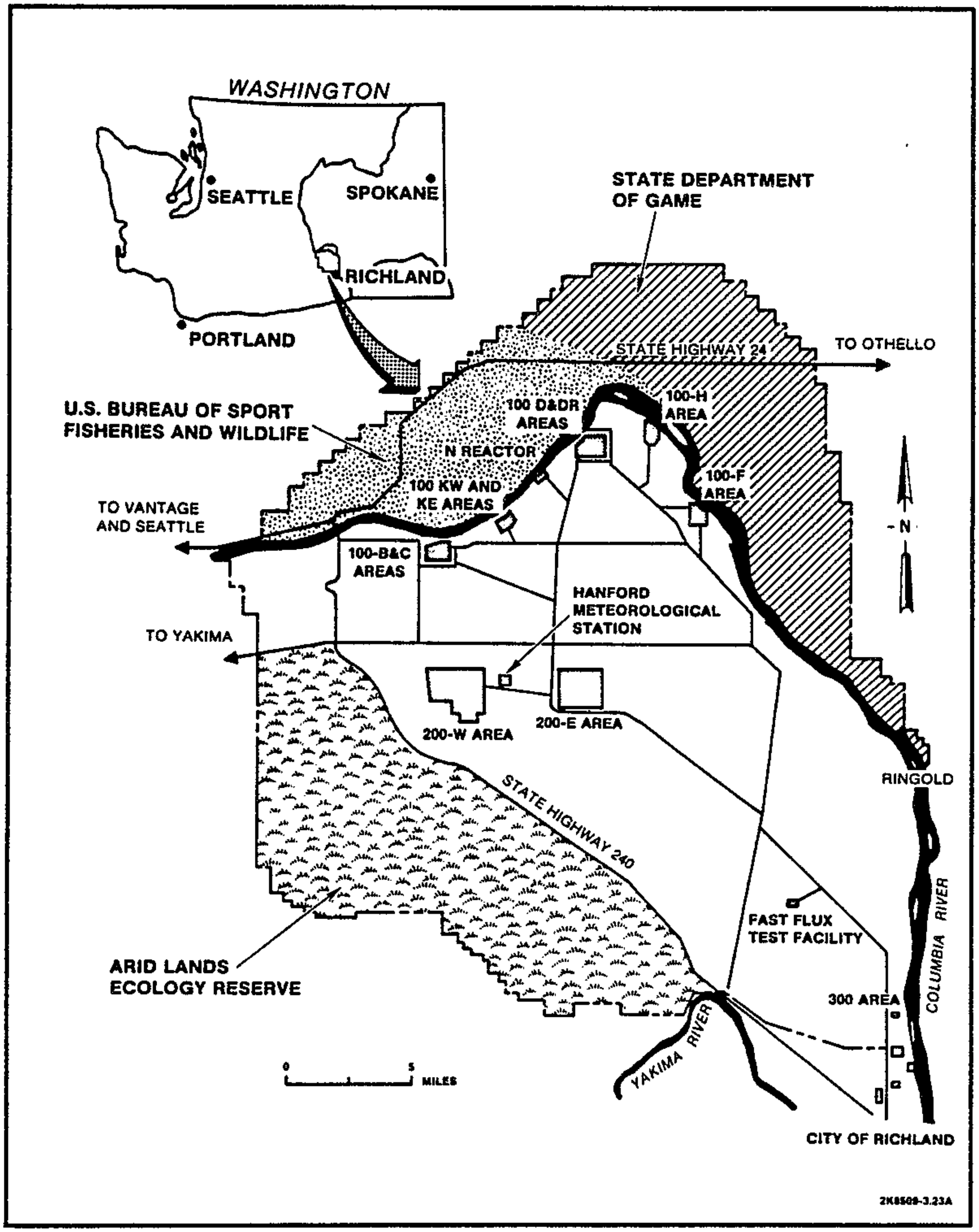


Figure 2-1. Surrounding Land Use.

2.2 216-B-63 TRENCH

The 216-B-63 trench is an open, unlined man-made earthen trench, approximately 4 ft (1.2 m) wide at the bottom, 1,400 ft (427 m) long, and 10 ft (3 m) deep. The trench is closed at the far end and does not convey effluent to any other facilities. The trench is located entirely within the perimeter fencing of the 200 East Area and has been in service since 1970. All discharge (see section 3.0) to the trench is also located entirely within the perimeter fencing of the 200 East Area. The trench is located northeast of B Plant and originates approximately 1,200 ft (366 m) east of Baltimore Avenue (fig. 2-2).

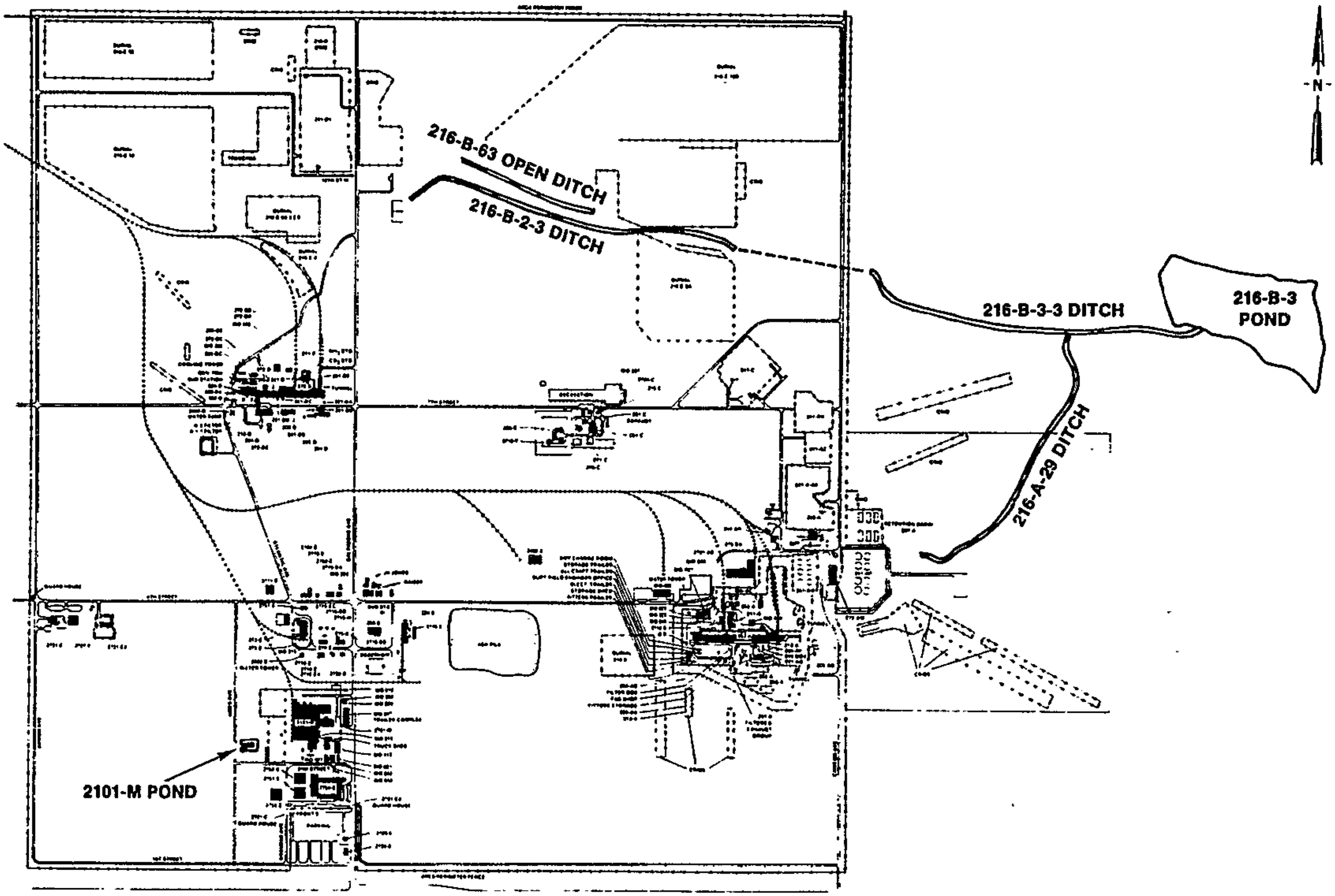
The B Plant chemical sewer discharges to the 216-B-63 trench through a 15-in. dia. (38-cm) vitrified clay pipe. The first 10 ft (3 m) of trench from the point of influent is lined with gravel (2-in.-minimum (5-cm) size, 1-ft-minimum (.3 m) depth) for erosion control.

2.3 TOPOGRAPHICAL MAPS

The map in appendix A is a general overview map of the entire Hanford Site property and the surrounding countryside. This figure is intended as a location map and illustrates the following:

- Facility boundary
- Surrounding land use including the Saddle Mountain National Wildlife Refuge and the Washington State Game Reserve to the north and the Arid Lands Ecological Reserve located to the west. Land east of the Hanford Site across the Columbia River is primarily farmland or a part of the Washington State Game Reserve. The surrounding land area is also shown in figure 2-1
- Contours sufficient to show surface water flow. Because of the large facility size, contours are shown at intervals of 20 ft (6.1 m)
- Fire control facilities located on the Hanford Site
- Locations of access roads, internal roads, railroads, and perimeter gates and barricades
- Longitudes and latitudes.

Figure 2-3 illustrates wind roses for various locations on the Hanford Site. Winds are predominately from the west.



2K8701-17.4

Figure 2-2. 200 East Area Site Plan.

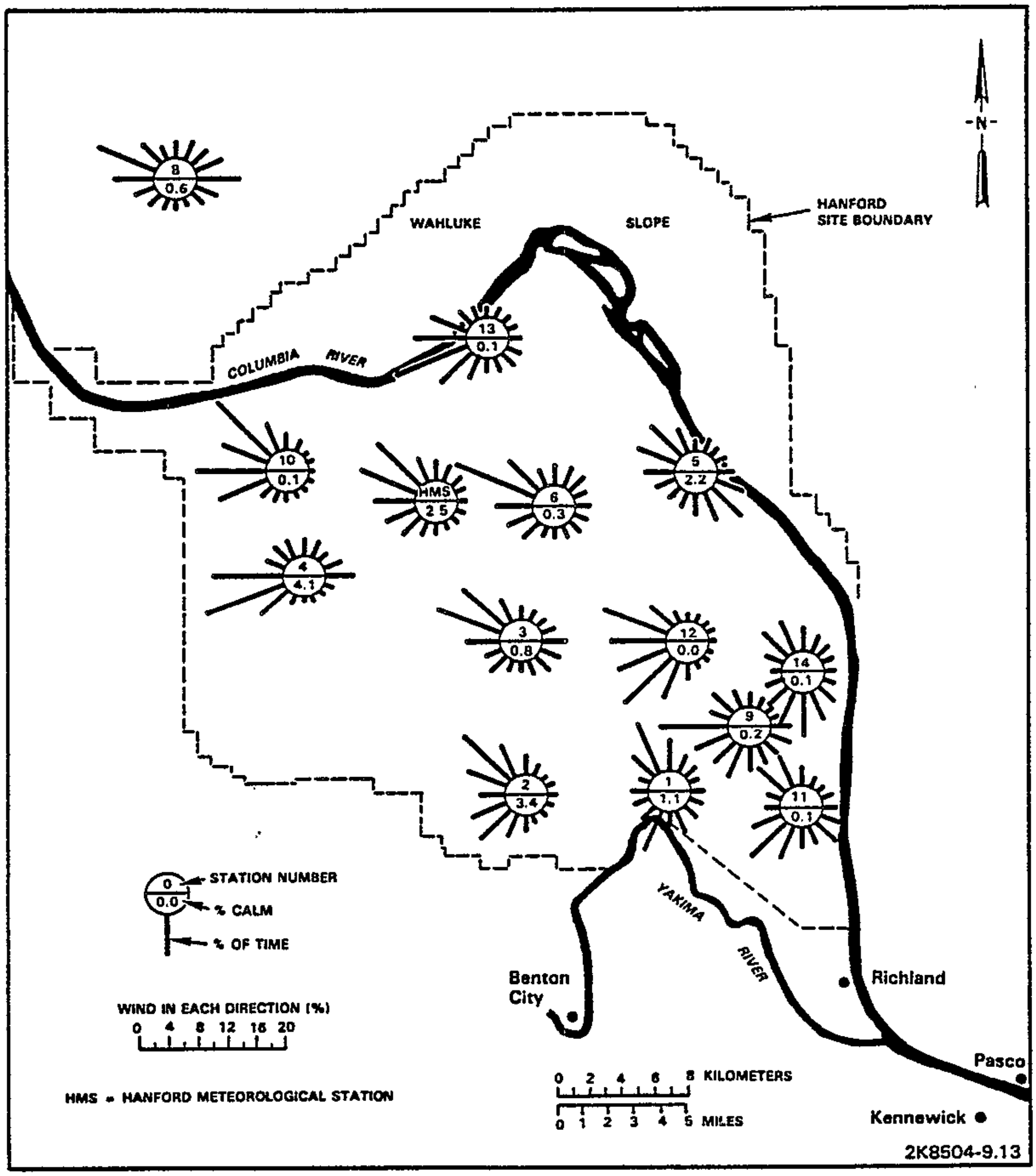


Figure 2-3. Wind Rose Telemetry Network.

The location of the 216-B-63 trench is shown on the 200 East Area Site Plan in figure 2-2.

A more detailed layout of the 216-B-63 trench and relevant discharge systems is shown in figure 2-4.

A water-table contour map of the uppermost aquifer showing the groundwater flow gradients for the Hanford Site facilities is located in appendix B. Further hydrology and geology information is discussed in section 5.0 of this closure/post-closure plan.

2.4 LOCATION INFORMATION

2.4.1 Seismic Consideration

The Hanford Site is not located within any of the political jurisdictions identified in appendix VI of 40 CFR 264 and WAC 173-303-420(3)(c) that are considered to be seismically active.

2.4.2 Floodplain Standard

The U.S. Army Corps of Engineers has calculated the probable maximum flood based on the upper limit of precipitation falling on a drainage area and other hydrologic factors such as antecedent moisture conditions, snowmelt, and tributary conditions that could lead to maximum runoff. The probable maximum flood for the Columbia River below Priest Rapids Dam has been calculated to be 1.4 million ft^3/s (4,000 m^3/s). The floodplain associated with the probable maximum flood is shown in figure 2-5 (Jamison 1982). The inundated area shown in figure 2-5 is greater than that which would be inundated during a 100-yr flood. The facility addressed in this closure/post-closure plan is located above the floodplain.

2.5 TRAFFIC INFORMATION

The 216-B-63 trench is located within the Hanford Site Controlled Access Area; these roadways cannot be accessed by the general public. The nearest public highway, Washington State Highway 240, is separated from the patrolled site areas by approximately 4 mi (6.4 km). The majority of traffic inside the Hanford Site boundaries consists of light-duty vehicles and buses used to transport employees to the various operations sites located within the Hanford Site.

9 0 1 1 7 5 4 0 6 4

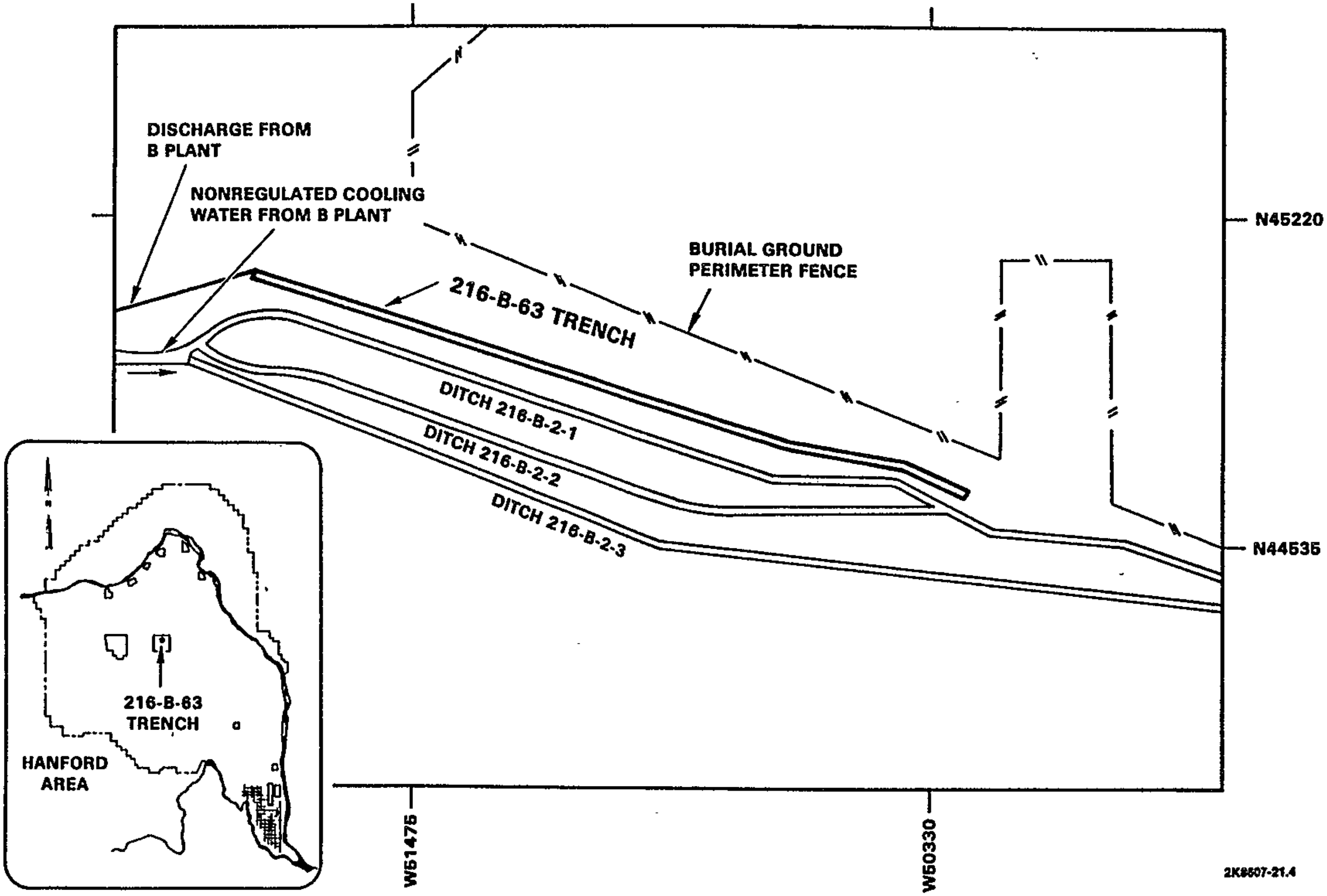


Figure 2-4. 216-B-3 Trench.

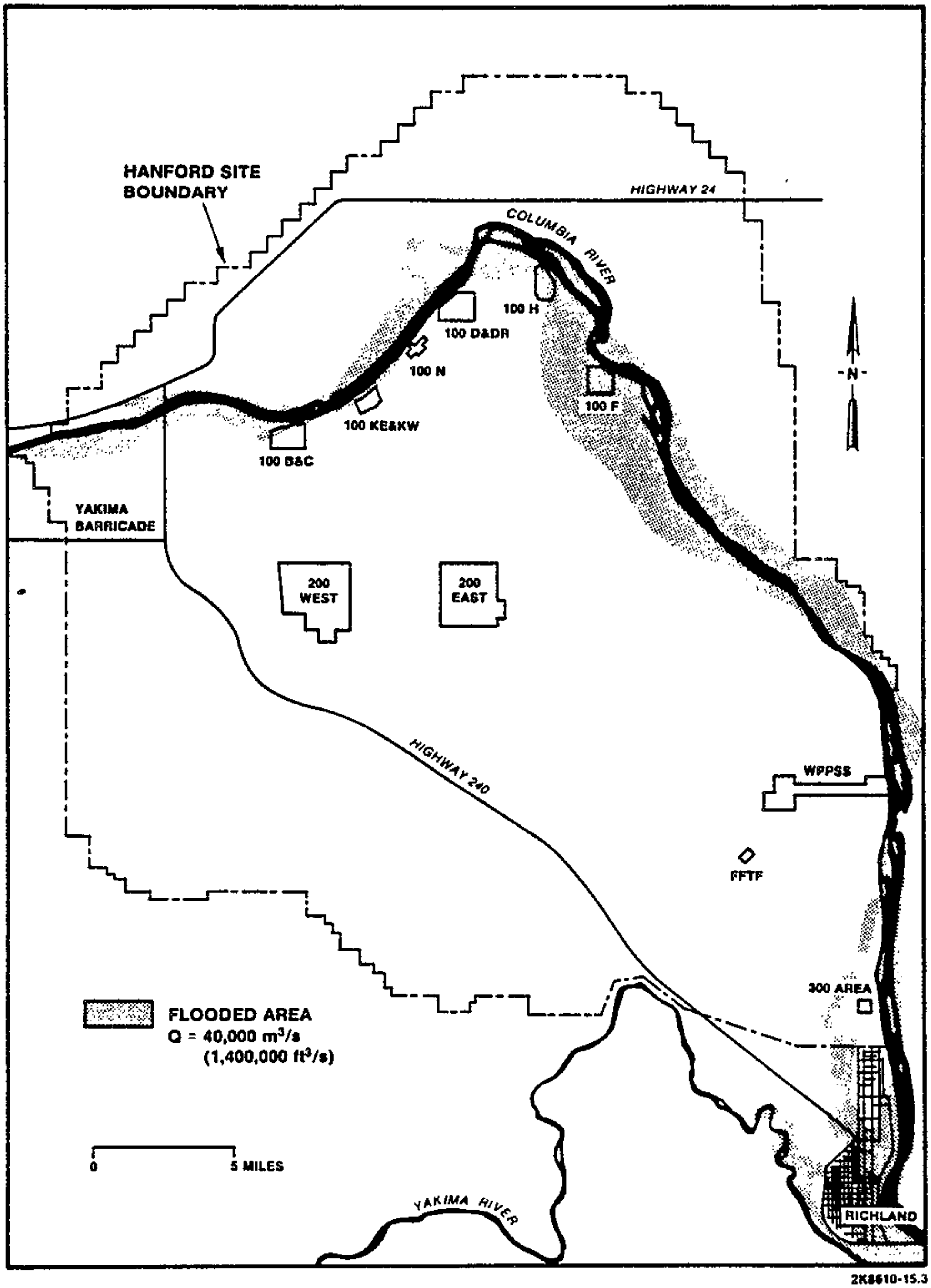


Figure 2-5. Inundated Area for the Probable Maximum Flood.

Figure 2-6 shows the major roads throughout the Hanford Site. These roads are classified as either primary or secondary routes. The primary routes include Routes 4S, 10, 4N, 3, and the portion of 11A east of route 4N. Both primary and secondary routes are constructed of bituminous asphalt (usually 2 in. (5 cm) thick, but the thickness of the asphalt layer will vary with each road) with an underlying aggregate base. The aggregate base consists of various types and sizes of rock found on the Hanford Site.

The point of discharge for the 216-B-63 trench is located approximately 2 mi (3.2 km) north of Route 4S. The only roads leading to this facility are enclosed within the 200 East Area perimeter fencing. Vehicle traffic on the roads within the 200 East Area in the vicinity of the point of discharge is light and no effluent is transported via roadways to the trench.

2.6 REFERENCES

EPA, 1986, Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, Title 40, Code of Federal Regulations, Part 264, U.S. Environmental Protection Agency, Washington, D.C.

Jamison, J. D., 1982, Standardized Input for Hanford Environmental Impact Statements, Part II: Site Description, PNL-3509, Part 2, Pacific Northwest Laboratory, Richland, Washington.

WAC, 1986, "Siting Standards," Dangerous Waste Regulations, WAC 173-303-420(3)(c), Washington Administrative Code, Olympia, Washington.

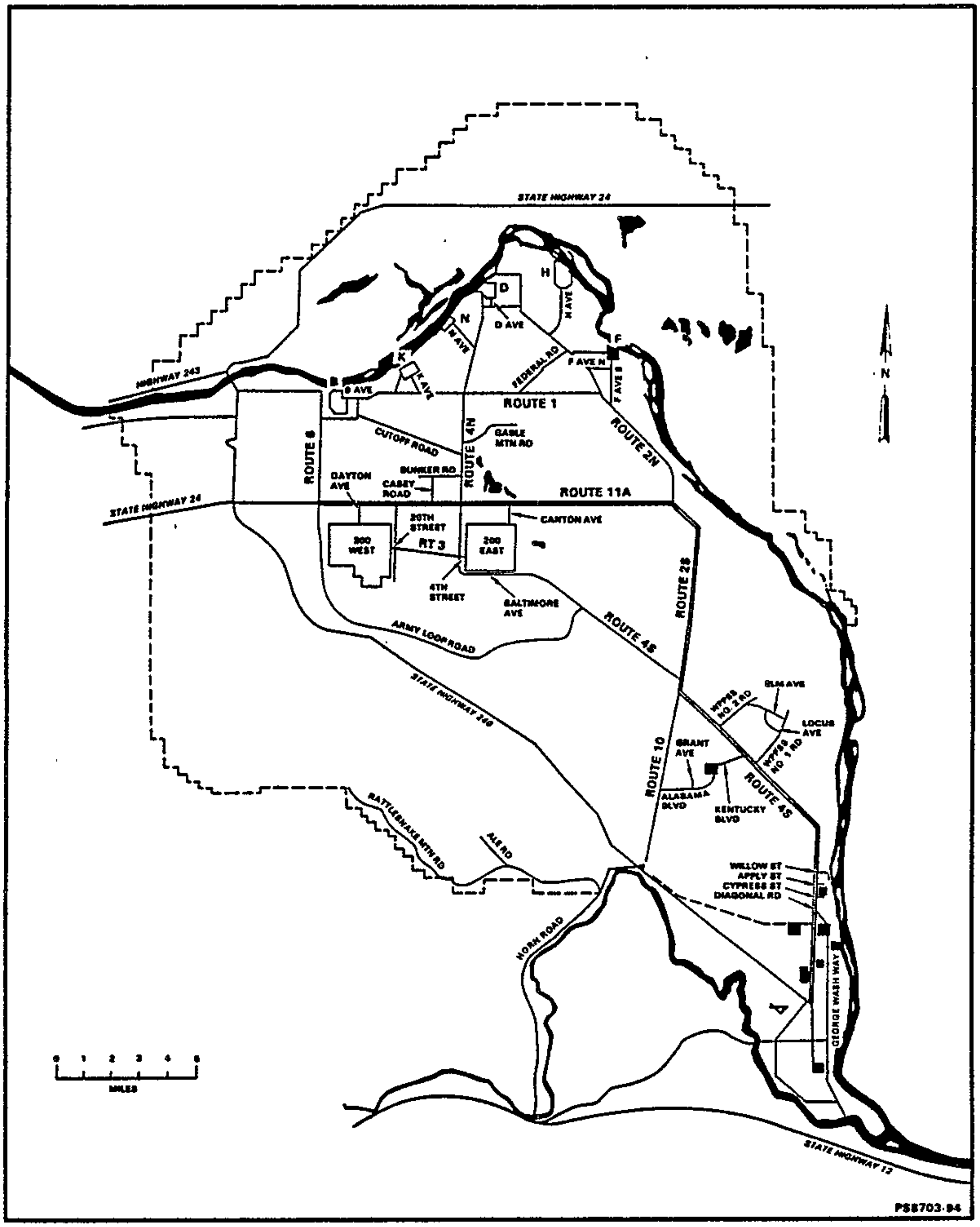


Figure 2-6. Hanford Site Roads.

3.0 WASTE CHARACTERISTICS

This section describes the chemical and physical characteristics of the liquid wastes discharged to the 216-B-63 trench. The 216-B-63 trench is an open unlined man-made earthen trench approximately 1,400 ft (427 m) long, 10 ft (3 m) deep, with a 4-ft-wide (1.2 m) bottom. The trench receives liquid waste from the B Plant stream, commonly known as B Plant chemical sewer. Sources of waste water discharged to the chemical sewer at B Plant include drains from chemical storage and chemical makeup areas, effluents from the plant water demineralizers, steam condensate from tank heating coils, cooling water from air compressors, rain water, office floor drains, and overflow from the B Plant water tower. The approximate average flow rate of waste water discharged to the 216-B-63 trench varies from 100,000 to 400,000 gal/d (378,000 to 1,408,000 L/d).

The only documented hazardous effluent discharged in the past consisted of regeneration solutions from the B Plant demineralizers. These effluents were routine corrosive discharges of aqueous sulfuric acid and sodium hydroxide solutions. The corrosive discharges occurred from 1970 until October 1985.

A number of upgrades and administrative controls have been instituted to prevent any further releases of hazardous waste. Included are neutralization of the demineralizer effluents with buffer solutions, installation of liquid-level alarms in chemical makeup tanks, neutralization of other corrosive wastes prior to discharge, and improvements to pH monitoring activities.

The current B Plant chemical sewer effluent has been sampled and analyzed for hazardous components. Preliminary analysis data are given in table 3-1. The preliminary data indicate that this waste stream is not a dangerous waste as defined in WAC 173-303. Further sampling and analytical efforts are underway for this stream; a minimum of four additional samples taken over a period of time (4 to 6 months) that is sufficient to represent the variability of the waste over time will be analyzed.

3.1 REFERENCE

WAC, 1986, Dangerous Waste Regulations, WAC 173-303, Washington Administrative Code, Olympia, Washington.

Table 3-1. 216-B-63 Trench Preliminary Analytical Data from B Plant Laboratory Sewerage. (sheet 1 of 2)

Analyte	Data (first sample, September 12, 1985)	Data (second sample, April 9, 1986)	Analyte	Data (first sample, September 12, 1985)	Data (second sample, April 9, 1986)
Aluminum	<1.5 E+02	5.0 E+02	Vanadium	<5.0 E+00	<5.0 E+00
Silver	<1.0 E+01	<1.0 E+01	Zinc	1.2 E+01	4.2 E+02
Barium	2.8 E+01	1.2 E+02	Chlorine	1.1 E+03	1.4 E+03
Beryllium	<5.0 E+00	<5.0 E+00	CN	1.7 E+01	<1.0 E+01
Calcium	1.7 E+04	1.7 E+05	Fluorine	1.5 E+03	2.8 E+03
Cadmium	2.0 E+00	<2.0 E+00	NO_3	5.3 E+02	<5.0 E+02
Chromium	<1.0 E+01	<1.0 E+01	PO_4	<1.0 E+03	<1.0 E+03
Copper	1.0 E+01	8.9 E+01	Sulfur	<1.0 E+03	<1.0 E+03
Iron	1.6 E+02	1.7 E+03	SO_4	1.0 E+04	2.9 E+06
Mercury	<1.0 E-01	1.3 E+00	Acetone	<1.0 E+01	<1.0 E+01
Potassium	1.2 E+03	6.6 E+03	Butyraldehyde	1.2 E+01	<1.0 E+01
Magnesium	3.6 E+03	4.8 E+04	Chloroform	<1.0 E+01	<1.0 E+01
Manganese	1.4 E+01	4.4 E+01	Phenol	<1.0 E+01	<1.0 E+01
NH_4	<2.0 E+01	<5.0 E+01	Alkanes	<1.0 E+01	1.3 E+01
Sodium	1.5 E+05	4.1 E+05	Amount (L/mo)	2.0 E+07	3.8 E+07
Nickel	<1.0 E+01	<1.0 E+01	pH	11.60	2.28
Osmium	<3.0 E+02	<3.0 E+02	Temperature (°C)	2.4 E+01	1.5 E+01
Lead	<3.0 E+01		Alpha activity (pCi/L)	3.7 E-01	3.1 E+00
Antimony	<1.0 E+02	<1.0 E+02	Beta activity (pCi/L)	1.5 E+01	5.1 E+01
Tin	<3.0 E+02		Conductivity (µS/cm)	1.2 E+03	
Strontium	<3.0 E+02	6.7 E+02	Total organic carbon	1.8 E+03	2.8 E+03
Uranium	5.1 E-01	4.6 E+00			

NOTE: Charges are assumed for inorganic analytes that were assayed as ions. All values are parts per billion except pH, which is dimensionless, and as otherwise indicated.

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Table 3-1. 216-B-63 Trench Preliminary Analytical Data from B Plant Laboratory Sewerage. (sheet 2 of 2)

Analyte	Data (third sample, April 15, 1986)	Data (fourth sample, June 30, 1986)	Analyte	Data (third sample, April 15, 1986)	Data (fourth sample, June 30, 1986)
Aluminum	1.6 E+02	<1.5 E+02	Vanadium	<5.0 E+00	<5.0 E+00
Silver	<1.0 E+01	<1.0 E+01	Zinc	6.7 E+01	9.0 E+00
Barium	2.3 E+01	2.8 E+01	Chlorine	1.4 E+04	9.6 E+02
Beryllium	<5.0 E+00	<5.0 E+00	CN	<1.0 E+01	<1.0 E+01
Calcium	1.8 E+04	1.7 E+04	Fluorine	7.5 E+03	<5.0 E+02
Cadmium	2.0 E+00	<2.0 E+00	NO_3	1.9 E+03	2.6 E+03
Chromium	<1.0 E+01	<1.0 E+01	PO_4	<1.0 E+03	<1.0 E+03
Copper	1.5 E+01	<1.0 E+01	Sulfur	5.0 E+02	<1.0 E+03
Iron	2.3 E+02	7.7 E+01	SO_4	1.3 E+05	1.1 E+04
Mercury	1.0 E-01	<1.0 E-01	Acetone	2.9 E+01	<1.0 E+01
Potassium	9.6 E+02	8.2 E+02	Butyraldehyde	<1.0 E+01	<1.0 E+01
Magnesium	4.2 E+03	4.0 E+03	Chloroform	1.0 E+01	<1.0 E+01
Manganese	8.0 E+00	1.0 E+01	Phenol	8.4 E+00	<1.0 E+01
NH_4	<5.0 E+01	<5.0 E+01	Alkanes	2.1 E+02	<1.0 E+01
Sodium	6.5 E+05	2.9 E+03	Amount (L/mo)	3.8 E+07	3.8 E+07
Nickel	1.1 E+01	<1.1 E+01	pH	12.67	6.40
Osmium	<3.0 E+02	<3.0 E+02	Temperature (°C)	1.5 E+01	2.6 E+01
Lead			Alpha activity (pCi/L)	1.3 E+01	<4.0 E+00
Antimony	1.0 E+02	<1.0 E+02	Beta activity (pCi/L)	2.7 E+01	3.1 E+02
Tin			Conductivity (µS/cm)		1.3 E+02
Strontium	3.0 E+02	<3.0 E+02	Total organic carbon	5.1 E+04	2.5 E+03
Uranium	3.5 E+00	4.7 E-01			

NOTE: Charges are assumed for inorganic analytes that were assayed as ions. All values are parts per billion except pH, which is dimensionless, and as otherwise indicated. PS187-3144-1

4.0 PROCESS INFORMATION

The 216-B-63 trench receives chemical sewer effluents from B Plant. B Plant includes a separations building (221-B) and an attached service building (271-B). Chemical sewer sources are listed in table 4-1. The water source for B Plant chemical sewer consists of 70% steam condensate and 30% raw water.

The effluent is routed to 216-B-63 trench by a 15-in. (38-cm) dia. vitrified-clay pipe. The 216-B-63 trench is approximately 1,400 ft (427 m) long, 4 ft (1.2 m) wide, 10 ft (3 m) deep, uncovered, and unlined. The trench is closed at the far end and does not convey effluent to any other facilities. All effluent infiltrates into the soil along the course of the ditch.

Average discharge into 216-B-63 trench ranges from 100,000 to 400,000 gal/d (378,000 to 1,408,000 L/d) during normal operations. Maximum discharge temperatures for all individual sources are under 100 °F (38 °C), except for the 221-B Pipe and Operating (P&O) Gallery steam condensate, which is 212 °F (100 °C). This source contributes 1,000 to 2,000 gal/d (3,780 to 7,560 L/d) under normal operating conditions. Flow rates are monitored by a 1½-in. (3.8-cm) flowmeter installed near the point where the effluent enters the trench.

Floor drains, funnel drains, and tank overflow/drain and heating and cooling coils in the 225-B (Encapsulation Facility portion of B Plant) were formerly discharged into the chemical sewer. This facility is shutdown and no longer produces waste. All the aforementioned drains and discharges have been covered or plugged.

Cooling water from B Plant that is sampled in 270-B retention basin and found to be outside specifications for radiation can be diverted to the 216-B-63 trench in an emergency situation. The chemical sewer could then be routed via the 216-B-2-3 ditch to 216-B-3 pond until the 216-B-63 trench had been cleaned.

Since 1984 a number of physical and administrative controls have been instituted at B Plant to prevent inadvertent release of regulated chemicals to the 216-B-63 trench. Administrative controls consist of revisions to operating procedures and institution of in-line neutralization for demineralizer effluent from the 217-B Building.

Operating procedures were revised to ensure that hazardous chemicals are not improperly disposed of. These procedures include the following:

- BO-001-016, "221-B Chemical Sewer Diversion to TK-10-1"
- BO-018-020, "Waste Handling and Concentration Chemical Sewer Handling"

Table 4-1. B Plant Chemical Sewer Sources.

Stream	Source
Floor, funnel, sink drains	221-B pipe and operating gallery (separation building) 271-B aqueous makeup area (service building) 271-B compressor room 217-B Demineralized Water Unit Building 225-BC Compressor Building 276-B Organic Makeup Building 224-B Building
Steam condensate	221-B pipe and operating gallery (chemical makeup tank farm) 211-B station steam supply SN-172 ammonia tank heating coil Various stream trace lines
Steam condensate and/or cooling water	TK-101, -102 aqueous makeup tank heating and cooling coils (211-B) HEDTA tank heating and cooling coils (211-B) TK-SF-121, -122 tanks heating and cooling coils (211-B) Various heating, ventilating, and air conditioning systems
Tank overflow and drain effluent	221-B scale tanks 221-B aqueous makeup tanks 271-B aqueous makeup tanks TK-H-317 resin fluidizing tank (271-B) 211-B ammonia pump basin 217-B tanks[a] 276-B tanks TK-CS-1, -2 tanks (212-B cask station) 224-B hot water tank 2902-B water tank
Sump effluent	211-B electrical gallery
Cooling water	211-B electrical gallery instrument air compressor
Rain water	Outdoor drain near 224-B Building (storage building)

[a]Includes neutralized demineralizer recharge effluent.

PST87-3144-7

- RHO-MA-111, Emergency Plan, Section 3.10.1, "Radioactive Liquid Discharges 271-B"
- RHO-MA-139, Environmental Protection Manual, Part B, "Standards for Response to Nonroutine Releases."

The in-line neutralization of demineralizer effluent entails injection of sodium carbonate into the dilute sulfate effluent and injection of monosodium phosphate into the dilute sodium hydroxide effluent. Additionally, the P&O Gallery scale tanks are sampled for pH prior to discharge and are neutralized if found to be out of specification.

Physical barriers currently in place consist of locks and tags in the aqueous makeup tank drains, and upgraded alarm and radiation sampling and alarm/automatic diversion. The effluent stream is continuously monitored at two locations for radiation and sampled weekly. An alarm is sounded in the 271-B Building if the radiation specification is exceeded and the stream is automatically diverted to TK-10-1 tank. This upgrade was completed in December 1986. At the same time, a continuous pH meter was installed, along with an alarm in the dispatchers' office. A specification has also been written for the analysis of separable organic phases as part of the weekly sampling.

Further upgrades, consisting of physical barriers, are planned to further minimize the risk of hazardous discharge into the B Plant chemical sewer. Overflow alarms are planned for the aqueous makeup tanks and tanks in 211-B Tank Farm for fiscal year 1988. High-level alarms are currently in place on the aqueous makeup tanks. Liquid-level alarms are planned for the P&O Gallery scale tanks for fiscal year 1989. Secondary containment diking is planned for tanks in 211-B Tank Farms for fiscal year 1989. A waste collection system for tank overflow is also planned for fiscal year 1989.

5.0 GROUNDWATER MONITORING

5.1 EXEMPTION FROM GROUNDWATER PROTECTION REQUIREMENTS

This section is not applicable because DOE-RL is not proposing to apply for an exemption from groundwater protection requirements at the 216-B-63 trench.

5.2 INTERIM STATUS PERIOD GROUNDWATER MONITORING DATA

No groundwater monitoring program for hazardous waste constituents is currently in place at the 216-B-63 trench, therefore no interim status groundwater monitoring data exists. Section 5.5 describes the proposed groundwater monitoring program for the 216-B-63 trench. Data obtained from this groundwater monitoring will be submitted to the WDOE and the EPA to satisfy the requirements for interim status groundwater monitoring as soon as such data are available.

5.3 REGIONAL HYDROGEOLOGY AND AQUIFER IDENTIFICATION

5.3.1 Hydrogeologic Setting

Groundwater has been monitored on the Hanford Site since the 1940s. While the main purpose of this monitoring was to track the movement of radionuclides in the groundwater, analysis of these groundwater monitoring data provides a sound overall view of the hydrogeology of the Hanford Site.

This hydrogeologic information, which was gathered from years of groundwater monitoring, was used to identify the uppermost aquifer and underlying hydraulically connected aquifers.

As a preface to the required discussion of the hydrogeologic properties underlying the 216-B-63 trench, the total regional and local meteorologic, geologic, and hydrologic properties of the Hanford Site are presented. The following is a summary of this information. This information was gathered from the documents listed in section 5.9. If more information is desired, these reports are available upon requirest.

Meteorological data are collected at a number of locations at the Hanford Site. Complete climatological data are available since 1945 for the Hanford Meteorological Station (HMS), located approximately 5 mi (8 km) south of the 100-N Area. Temperature and precipitation data from the old Hanford Townsite (located approximately 3 mi (4.8 km) downriver from N Reactor) are available for the period 1912 through 1943, which is (Stone et al. 1983).

Average monthly temperatures at HMS range from a low of 29.3 °F (-1.5 °C)in January to a high of 76.4 °F (24.7 °C) in July. The maximum monthly average temperature at the HMS during the winter is 44.5 °F (6.9 °C), and the minimum is 21.4 °F (-5.9 °C), both occurring during February. The maximum monthly average temperture at HMS during the summer is 81.8 °F (27.7 °C) in July, and the minimum is 63.0 °F (17.2 °C) in June. The annual average relative humidity at the HMS is 54%, with a maximum of about 75% during the winter months and a minimum of about 35% during the summer months.

Average annual precipitation at the HMS is 6.3 in. (16 cm). The months of November through February account for nearly one-half of the annual precipitation. Fewer than 1% of the days have rainfall greater than 0.5 in. (1.3 cm). The maximum 24-h rainfall event in a 100-yr period was predicted to be 2.0 in. (5 cm) (Stone et al. 1983). Total precipitation over the entire Pasco Basin is estimated at less than 8 in. (20 cm) annually. Mean annual runoff is generally less than 0.5 in. (1.3 cm) for most of the basin, and the basin-wide runoff coefficient, for all practical purposes, is zero (Leonhart 1979).

Average annual evaporation on the Hanford Site can exceed 60 in. (152 cm). Average annual lake evaporation ranges from approximately 39 to over 42 in. (99 to over 107 cm). Actual evapotranspiration for a 6-in. (15 cm) waterholding capacity soil (uncultivated) is approximately 7.5 to 8.5 in. (19 to 22 cm) (Leonhart 1979; Wallace 1978). Studies by Last et al. (1976), Brown and Isaacson (1977), and Jones (1978) suggest that much of the percolated water is subsequently lost by evapotranspiration.

In summary, the Hanford Site climate is mild and dry with occasional periods of high winds. Summers are hot and dry; winters are less dry, but are relatively mild for this latitude. Average maximum temperatures occur in July, and average minimum temperatures occur in February. Average relative humidity is lowest in the summer and highest in the winter. Average annual precipitation is about 6.3 in (16 cm). The 100-yr, maximum-predicted rainfall event in a 24-h period is 2.0 in. (5 cm). Potential evapotranspiration rates greatly exceed annual precipitation rates, but much of this precipitation is received between November and February when evapotranspiration rates are low. The highest monthly average winds occur during the hot summer, creating higher evaporative potentials.

5.3.2 Regional Geologic Setting

5.3.2.1 Introduction. The Hanford Site in south-central Washington State is located in the Columbia Plateau Physiographic Province, which is generally defined by a thick accumulation of basaltic lava flows. These flows extend laterally from central Washington eastward into Idaho and southward into Oregon (fig. 5-1). Deformation of these lava flows has formed a series of broad structural and topographic basins. The Hanford Site is located in one of these basins, the Pasco Basin, at the confluence of the Yakima and Columbia Rivers.

The Pasco Basin is bounded on the north by the Saddle Mountains; on the west by Umtanum Ridge, Yakima Ridge, and the Rattlesnake Hills; on the south by a series of doubly plunging anticlines that merge with the Horse Heaven Hills; and on the east by a broad monocline, locally known as the Jackass Mountain Monocline (fig. 5-2). Very little topographic relief exists within the Pasco Basin.

The stratigraphy underlying the Pasco Basin is divided into six major units. They are, in general ascending order: (1) the basement rocks, (2) the Columbia River Basalt Group, (3) the Ellensburg Formation, (4) the Ringold Formation, (5) the early Palouse soil, and (6) the Hanford Formation. Alluvium, colluvium and eolian sediments locally veneer the surface of the Pasco Basin. These six units are described in the following sections.

5.3.2.2 Basement Rocks. The basement rocks underlying the basaltic lava flow in the Pasco Basin are of uncertain composition. Pre-basalt rock types can be projected from the margins of the Columbia Plateau, 100 to 150 mi (160 to 240 km) away, and are inferred to exist locally in the central plateau area, perhaps beneath the Pasco Basin. For example, data from the Basalt Explorer Well northeast of the Pasco Basin indicate that sandstones and shales comparable to the sedimentary rocks of the Cascade Range may lie beneath the Pasco Basin. Recent magnetotelluric surveys indicate a very deep conductive section, possibly representing these sediments (BWIP 1978). Beneath these sediments are probably granitic rocks comparable to those in the Okanogan Highlands; the Snoqualmie Pass area of the Cascade Range; the Moscow Basin, Idaho; the base of the Basalt Explorer Well; and parts of the core of the Blue Mountains, Oregon. There, granitic rocks were intruded into largely Paleozoic and early Mesozoic metavolcanic and metasedimentary rocks whose equivalents might also occur beneath the Pasco Basin.

5.3.2.3 Columbia River Basalt Group. The regional geology surrounding the Pasco Basin is dominated by a tholeitic flood basalt province in the Columbia Plateau and adjacent Blue Mountains of Washington, northern Oregon, and adjacent Idaho (see fig. 5-1). The flood basalt province is a layered mass of more than 50,000 mi^3 (208,420 km^3) of basalt covering an area of more than 60,000 mi^2 (155,400 km^2). The flood basalts and associated rocks form a plano-convex lens. The upper surface of the lens slopes gently inward except where locally modified by fold systems (see fig. 5-1). Basin deformation and the development of fold systems in the Columbia Plateau started between 16 and 13 million yr before present and continued through Columbia River Basalt time (Bentley 1977).

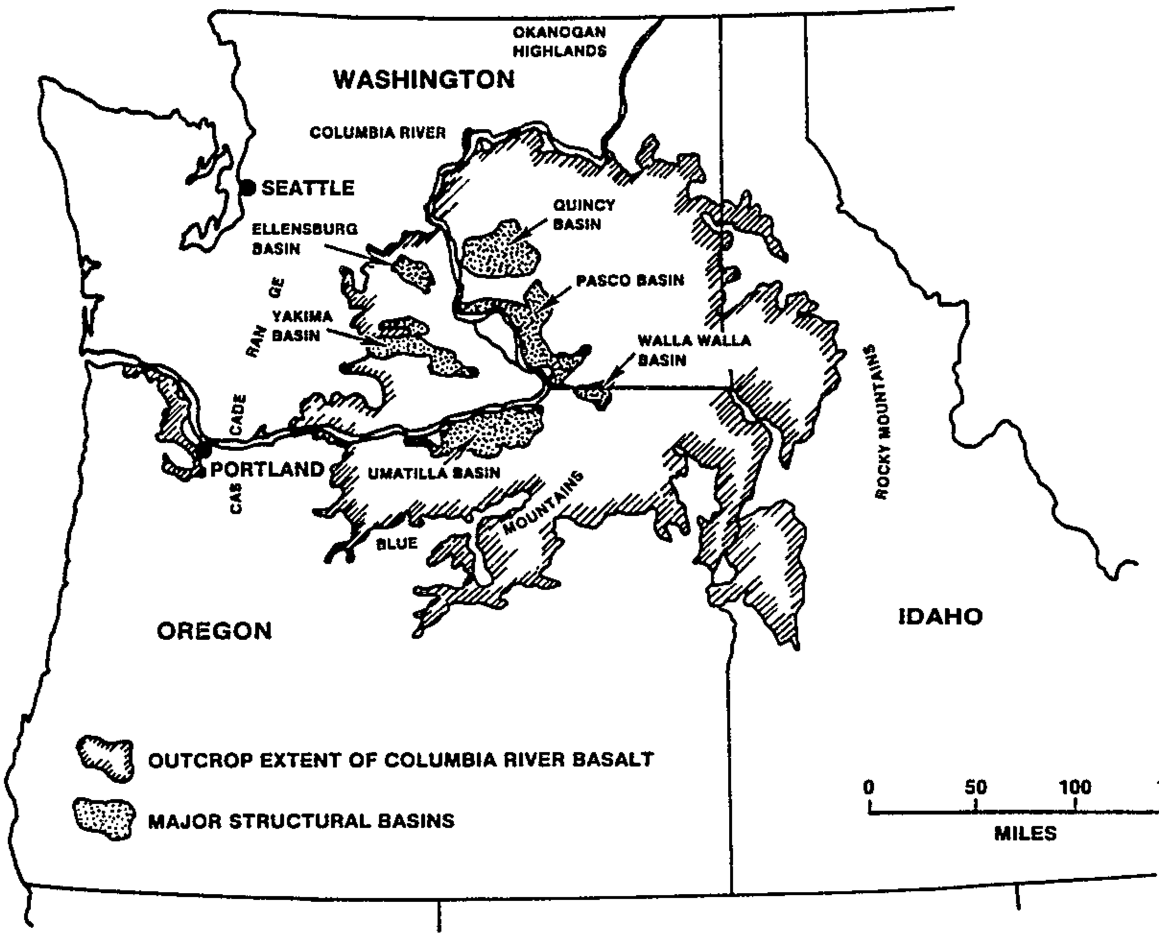


Figure 5-1. Geographic Extent of the Columbia River Basalt Group.

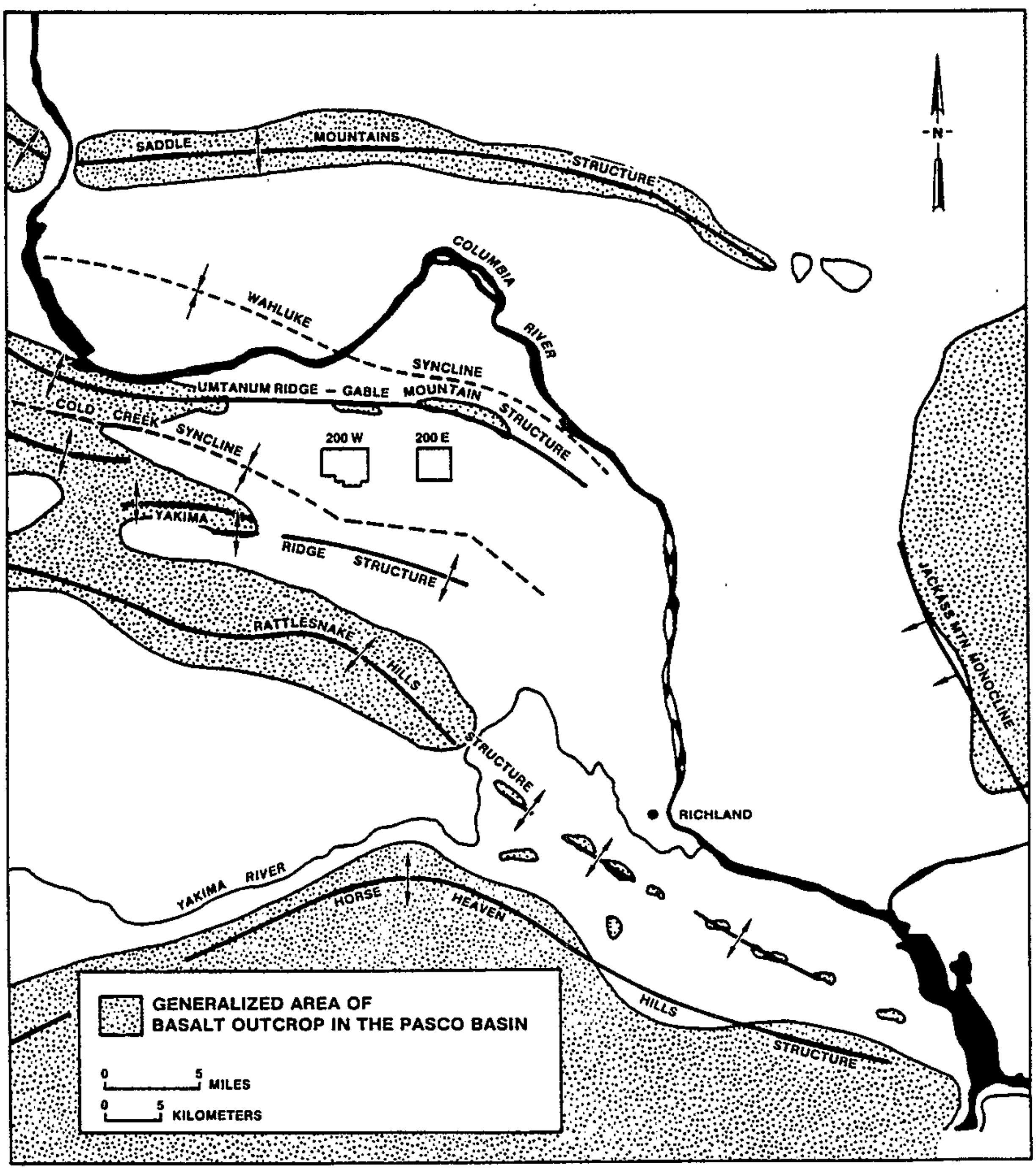


Figure 5-2. Structural Geology of the Pasco Basin.

The basalts emanated from linear fissure systems in the eastern and southern portions of the Plateau (Swanson et al. 1975; Waters 1961). Most of the basalt was emplaced during a 3-million-yr volcanic pulse between 16 and 13 million yr before present during the Miocene Epoch (Baski and Watkins 1973). However, sporadic fissure eruptions continued until about 6 million yr before present (McKee et al. 1977).

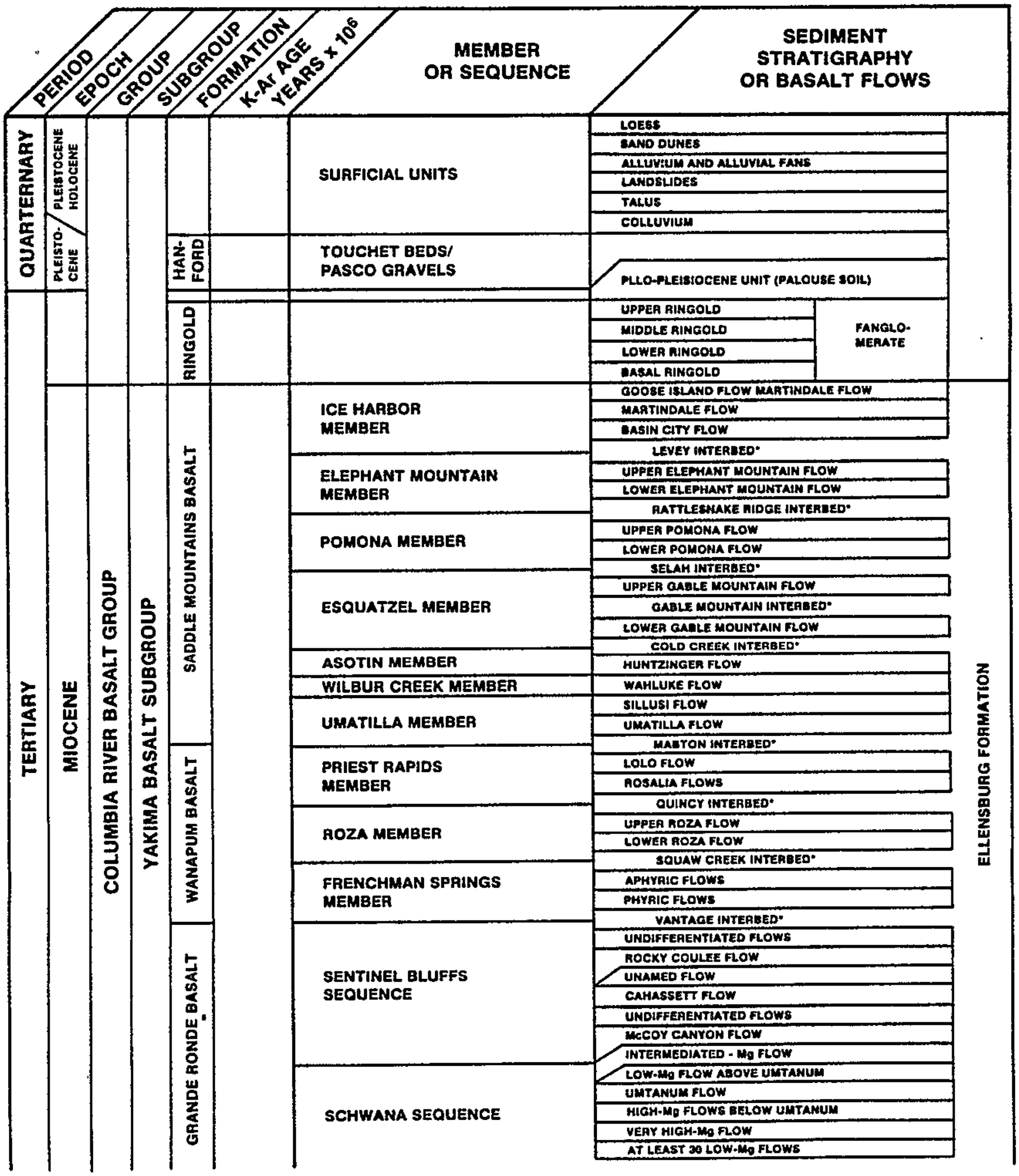
The flood basalts are collectively designated the Columbia River Group, which has been subdivided into five formations (fig. 5-3) (Ledgerwood et al. 1978; Swanson et al. 1978). The lower two formations are the Imnaha Basalt (Hooper 1974) and the Picture Gorge Basalt (Swanson et al. 1975). The upper three formations, the Grande Ronde Basalt, the Wanapum Basalt, and the Saddle Mountains Basalt collectively constitute the Yakima Basalt Subgroup (Swanson et al. 1978).

In the Pasco Basin near the center of the area covered by the Columbia Plateau, the basalt sequence is more than 10,000 ft (3,048 m) thick (Raymond and Tillson 1968) and perhaps as much as 19,000 ft (5,791 m) thick (BWIP 1978). In the Pasco Basin, a 5,000-ft-thick (1,524-m) sequence of Columbia River Basalt apparently overlies a series of older basalt of Oligocene to Eocene age (Swanson et al. 1978). Approximately 100 basalt flows, including both the Columbia River Basalt Group and older lavas, have been identified from geophysical logs obtained from a 10,655-ft-deep (3,248-m) borehole located along the western margin of the Pasco Basin (Swanson et al. 1978).

5.3.2.4 Ellensburg Formation. Within the upper part of the Columbia River Basalt sequence, sediments were transported into the central portion of the Columbia Plateau between basalt eruptions. These sediments, which include tuffs and tuffaceous sediments of many kinds, in part now altered to clay, form the Ellensburg Formation (Swanson et al. 1978). Many basalt flows above the Vantage sandstone interbed are capped locally by stream-deposited sediments. The extent and thickness of the sediments generally increase upward in the section.

About 1.5 million yr ago, ancestral river systems were crossing central Washington, laying down trains of gravel, sand, silt, and clay comparable to today's Columbia River and Snake River sediments. As the plateau subsided, the ancestral Columbia River returned by gravity to the center of the Columbia Plateau, leaving sediment trains as a mark of its earlier courses. East of the present course of the Columbia River, sediments are virtually nonexistent between basalt flows. This attests to the fact that the ancestral Columbia River source was limited to the western half of the Columbia Plateau.

5.3.2.5 Ringold Formation. Deformation during the later stages of Columbia River Basalt volcanism resulted in the emergence of the Yakima fold system in the western plateau. Growth of these folds created a system of



* THE INTERBEDS ARE STRATIGRAPHICALLY CONTAINED IN THE ELLENSBURG FORMATION

2K8701-6.16

Figure 5-3. Stratigraphic Nomenclature of the Pasco Basin.

structural ridges and basins, which include: the Ellensburg Basin, Quincy Basin, Yakima Basin, Pasco Basin and Umatilla Basin (see fig. 5-1). Thick sequences of sediments transported from the surrounding highlands accumulated in these basins.

In the Pasco Basin, the Miocene-Pliocene Ringold Formation (Gustafson 1978) was deposited in response to a flattening of the gradient of the Columbia and Snake River systems, perhaps related to the uplift of the Horse Heaven Hills (Newcomb 1958; Newcomb et al. 1972). The Ringold formation in the Pasco Basin accumulated to a thickness of up to 1,200 ft (365 m).

The Ringold Formation can generally be divided into four units on the basis of texture: sand and gravel of the basal Ringold unit; clay, silt, and fine sand with lenses of gravel of the lower Ringold unit; occasionally cemented sand and gravel of the middle Ringold unit; and silt and fine sand of the upper Ringold unit (Brown 1959) (fig. 5-3 and 5-4).

The basal portion of the Ringold Formation is, in general, conformable with the surface of the underlying basalt bedrock. The lower Ringold unit is thickest in the central portion of the Pasco Basin and thins to the basin's margins. The matrix supported conglomerate of the middle Ringold unit overlies the lower unit. The upper Ringold unit is generally confined to the margins of the basin; elsewhere, it either was not deposited, or has been eroded by ancestral river systems and by Pleistocene catastrophic flooding of the basin.

5.3.2.6 Early Palouse Soil. An eolian silt and fine sand (loess) overlie part of the eroded surface of the Ringold Formation in the western part of the Hanford Site (Brown 1970) (see fig. 5-3 and 5-4). Elsewhere, the silt was not deposited or was eroded during Pleistocene catastrophic flooding. The silt is considered to be the equivalent of early loess deposits of the Palouse Hills in eastern Washington and western Idaho. It indicates a climate comparable to that of today, with effective wind transport and deposition of sediment.

5.3.2.7 Hanford Formation. The Ringold Formation and the basalts and sedimentary interbeds were locally eroded and truncated by multiple floods that occurred as ice-dammed lakes released catastrophic torrents of water and ice when the ice dams were breached during Pleistocene glaciation (Bretz 1959; Baker 1973; Fecht and Tallman 1978). The floods scoured the land surface, leaving a network of buried channels crossing the Pasco Basin.

The glaciofluvial sediments in the Pasco Basin, informally named the Hanford Formation, were deposited on the Columbia River Basalt Group and Ringold Formation (see fig. 5-3 and 5-4). These sediments can be divided into the coarser sand and gravel which are referred to as the Pasco Gravels (Brown 1975), and the finer sand and silt units called the Touchet Beds (Flint 1938).

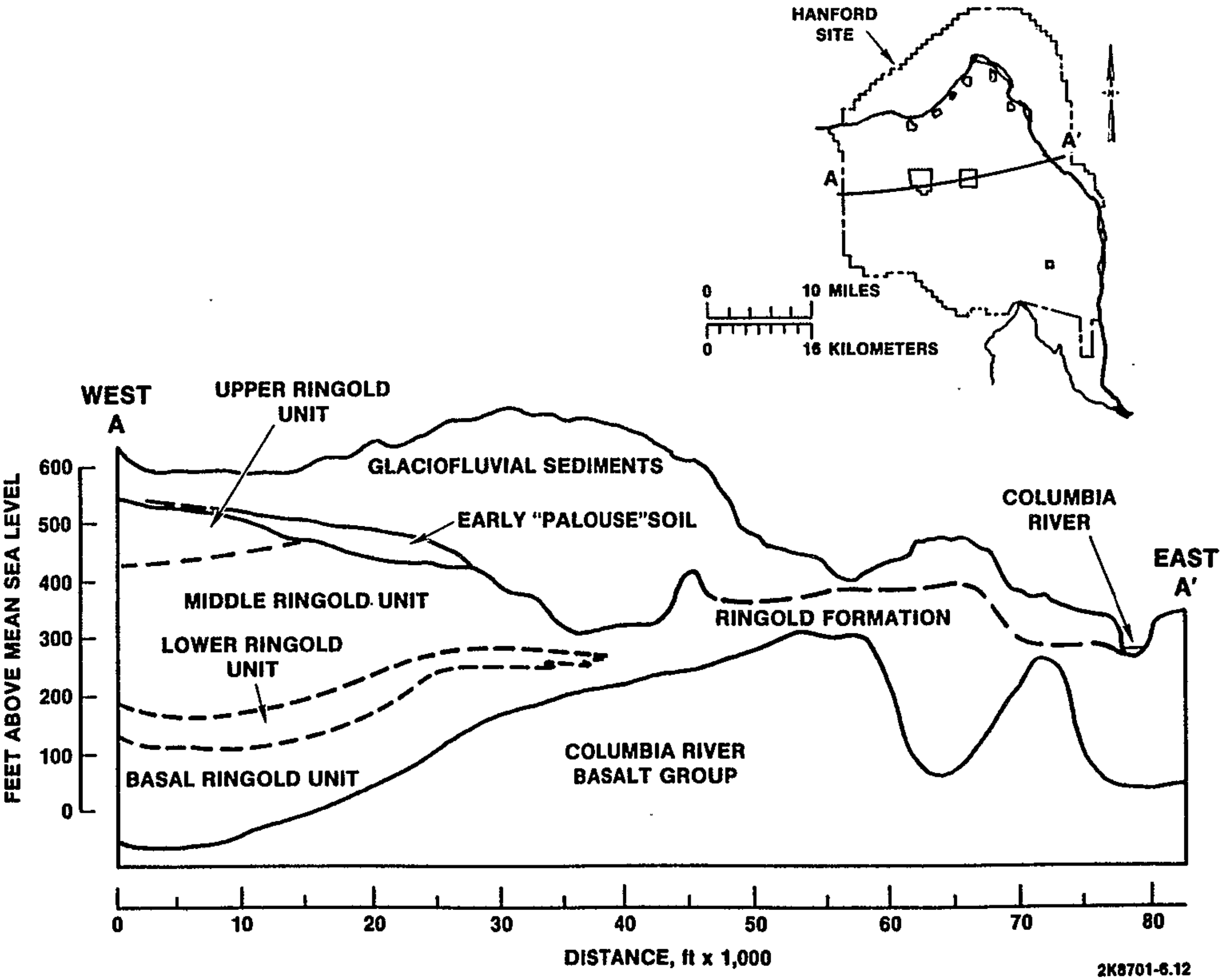


Figure 5-4. Generalized Geologic Cross, Section Through the Hanford Site.

The Touchet Beds represent low-energy (slackwater) sediments deposited in glacial Lake Lewis, which formed when flood waters were backed up behind the Wallula Gap constriction (Flint 1938). The Pasco Gravels represent high-energy deposition in areas of more rapid water flow. In general, the Touchet Beds are found on the margins of the basin and the Pasco Gravels in and near the center of the basin. The characteristic variability of sediment size and degree of sorting within the gravel unit can be attributed to changes in water velocity and water level that occurred during the flooding process. The thickness of the Hanford Formation varies significantly within the basin, with the thickest occurrence in the region of buried channels.

5.3.2.8 Eolian Deposits. Loess and sand dunes mantle the surface of the Pasco Basin (Lillie et al. 1978). These deposits are primarily reworked sediments of the Hanford Formation from surrounding areas. The thickness of the wind-blown sediments varies considerably, ranging from zero to more than 30 ft (9 m) in some dunes.

The land surface has been only slightly modified since the deposition of the Hanford Formation. Eolian erosion and deposition have resulted in minor deflation and deposition of sand and silt veneers up to 25 ft (8 m) thick.

5.3.3 Geology of the 200 East Area

The 216-B-63 trench lies within the 200 East Area. Beneath the 200 Areas, the Ringold Formation has been divided into four textural units: (1) sand and gravel of the basal Ringold member; (2) clay, silt, and fine sand with minor gravel lenses of the lower Ringold member; (3) occasionally cemented sand and gravel of the middle Ringold member; and (4) silt and fine sand of the upper Ringold member (Brown 1959).

The basal Ringold directly overlies the uppermost basalt flow. The silts and sands of the lower member were deposited in still-forming synclinal depressions. This low-energy fluvial/lacustrine deposit is thickest in the Cold Creek Syncline. The unit pinches out on the flanks of the Umtanum-Gable Mountain Structure where it apparently was not deposited. The middle member is the thickest Ringold member beneath the 200 East Area. This member is characterized as a silty, sandy gravel. In general, the upper part of the Ringold is not indurated except for isolated cementation from calcium carbonate, while the lower part of the unit is moderately-to-well indurated. The upper Ringold member is not present beneath the 200 East Area, apparently stripped by erosional processes.

Above the Ringold lies the Plio-Pleistocene Unit. Normal fluvial processes as well as Pleistocene catastrophic flooding apparently stripped much of this eolian silt and fine sand from beneath the 200 Areas.

The Pasco gravels (Tallman et al. 1979) facies of the Hanford Formation is composed of poorly sorted, subrounded-to-angular clasts that commonly display forset bedding (Myers et al. 1979). These sediments indicate high-energy depositional environments. The Touchet Beds facies consists of rhythmically bedded sequences of graded silt, sand, and minor gravel units. These deposits are limited to areas where slack-water conditions occurred during the impoundment of flood waters behind the Wallula Gap constriction (Tallman et al. 1979; Myers et al. 1979).

Eolian sediments consisting of both active and inactive sand dunes locally veneer the surface of the 200 Areas.

Figure 5-5 is a generalized geologic column for the 200 East Area.

5.3.4 Regional Hydrologic Setting

5.3.4.1 Surface Hydrology of the Hanford Site and Surrounding Pasco Basin. In the Pasco Basin, the Columbia River receives surface drainage from several adjacent basins. These major tributaries include the Yakima, Snake, and Walla Walla Rivers. No perennial streams are supported by hydrologic systems operating solely within the Pasco Basin. Stream flow within the Pasco Basin is recorded as inflow at the U.S. Geological Survey gauge below Priest Rapids Dam and outflow at the gauge below McNary Dam. Average annual flow at these stations is 87×10^6 and 140×10^6 acre-ft/yr, (10×10^{12} and 17×10^{12} m^3/yr) respectively. A total gauged flow of approximately 45×10^6 acre-ft/yr (5.5×10^{10} m^3/yr) enters from tributaries, and an additional 2.3×10^5 acre-ft/yr (2.8×10^8 m^3/yr) enter as irrigation returns.

The Hanford Site occupies approximately one-third of the land area within the Pasco Basin. Primary surface-water features associated with the Hanford Site include the Columbia and Yakima Rivers. Several artificial surface ponds and ditches are present, and are generally associated with fuel and waste processing activities (fig. 5-6).

The section of the Columbia River along the Hanford Site Reach has been inventoried and was described in detail by the U.S. Army Corps of Engineers (COE 1977). Flow along this reach is controlled by the Priest Rapids Dam. Several drains and intakes are also present along this reach. Most notably, these include irrigation outfalls from the Columbia Basin Irrigation Project and Hanford Site intakes for the on-site water export system. Intake and outfall structures for the Hanford Generating Project and N Reactor also occur in the Hanford Reach.

West Lake, a shallow pond (3 ft (1 m) deep), is the only natural pond on the Hanford Site. The pond generally averages 10 acres (0.04 km^2) in size. A number of man-made ditches and ponds are used for the routine disposal of chemical processing cooling waters, plant cooling water and several laboratory waste water streams (ERDA 1975).

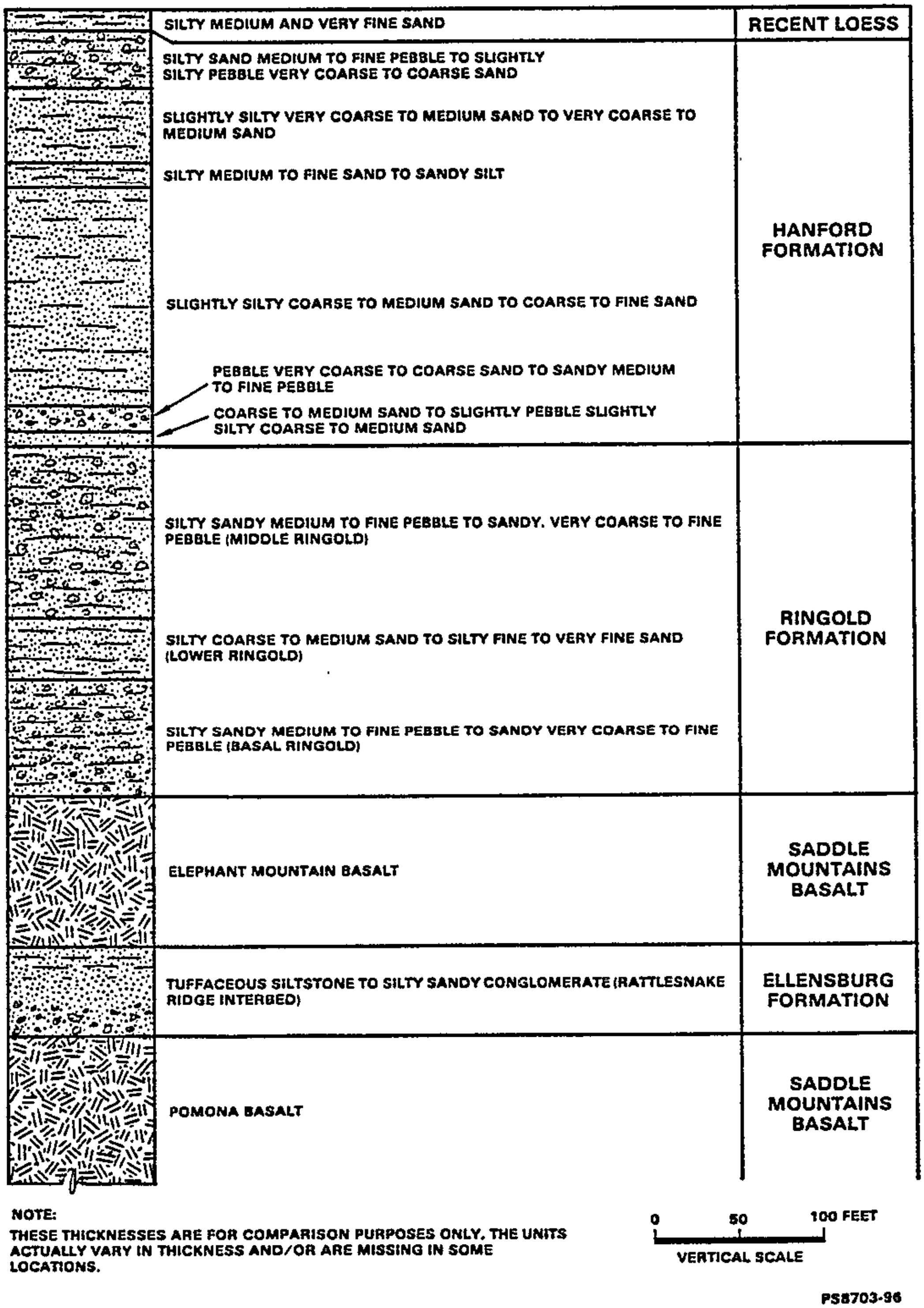


Figure 5-5. Generalized Stratigraphic Column for 200 East Area.

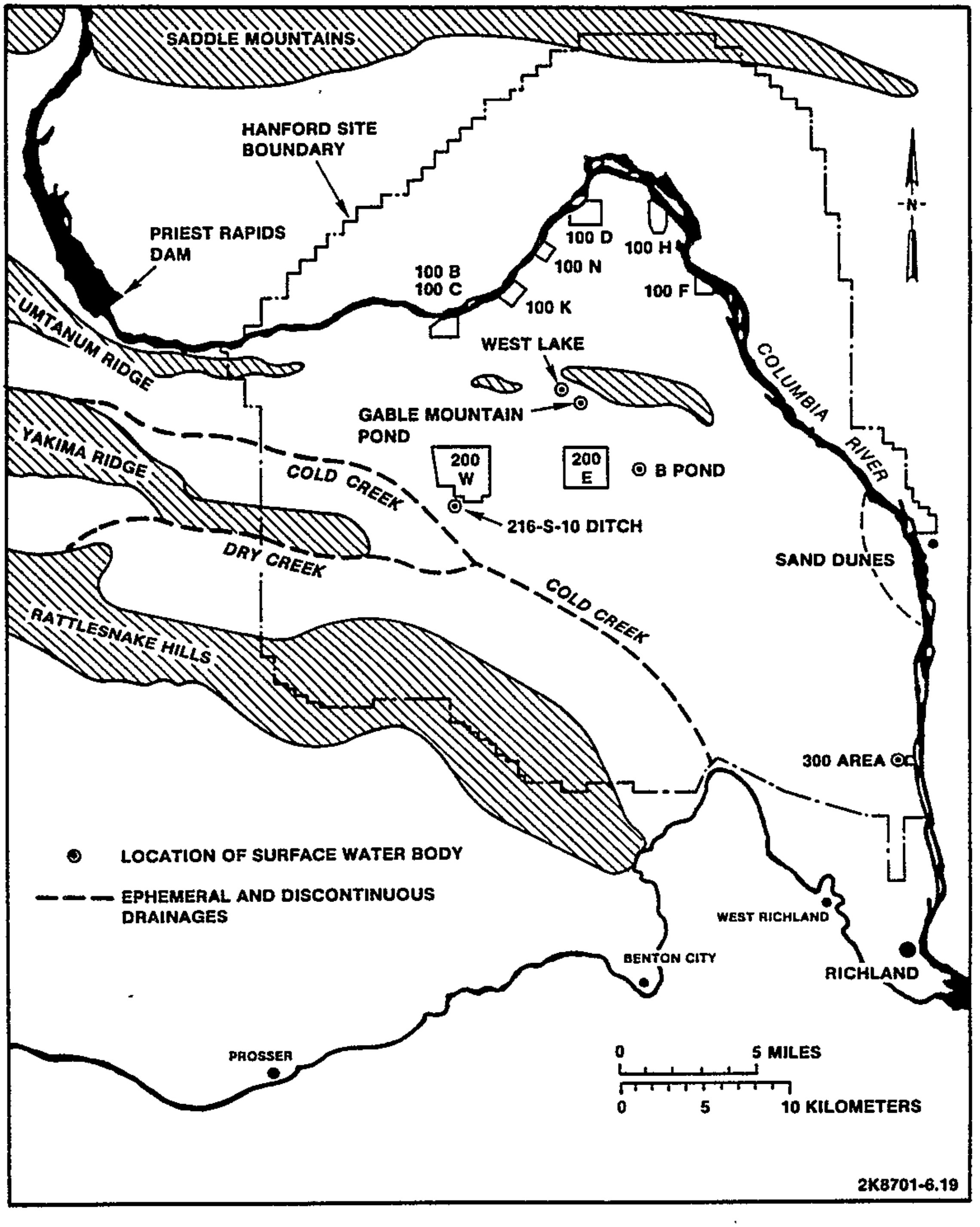


Figure 5-6. Surface Water Bodies Including Ephemeral Streams on the Hanford Site.

The Cold Creek watershed (area draining into Cold Creek) is located along the western boundary of the Pasco Basin. The 200 East Area lies outside the Cold Creek watershed. Cold Creek, trending northwest-southeast within the wash, is the only defined channel within the southeastern portion of the Hanford Site watershed (see fig. 5-6). The drainage system within the Cold Creek watershed may be described as ephemeral and discontinuous.

5.3.4.2 Aquifer Identification.

5.3.4.2.1 Background. The subsurface of the Hanford Reservation is underlain by various geologic units having widely different water-bearing properties. The rock types include: unconsolidated silts, sands and gravels; semiconsolidated lake and stream sediments; and dense basalts with interbeds separating individual flows. From a hydrologic standpoint the most permeable horizons are the sands and gravels of the Upper Ringold Formation and the Pasco Gravels. The water table over the western portion of the Hanford Reservation lies at the top of the Ringold Formation. However, between the high terrace plateaus and the Columbia River, the water table rises above the Upper Ringold and intersects the overlying Pasco Gravels.

The uppermost aquifer lies between the water table and the silts and clays of the Middle and Lower Ringold Formation. In general, groundwater in these unconsolidated and semiconsolidated sediments occurs under unconfined or water table conditions, although locally confined zones exist. Some semiconsolidated gravels and sands are locally found in the Lower Ringold Formation. These beds are usually separated from the overlying unconfined aquifer by a layer of silt and clay of vaiable thickness. These sands, where present, constitute the uppermost confined aquifer.

The Ringold Formation overlies a warped and severely deformed layer of basalt. The Columbia River basalt series within the Pasco Basin has, in general, a saucer-shaped synclinal structure. It is a layered sequence of flows that were extruded as highly fluid lava in Miocene and early Pliocene time. Narrow zones of rubbly, permeable scoria somewhat similar to flow breccia occur at the top of most flows and are quite permeable. Some of these permeable zones in the basalt constitute good confined-aquifer systems.

During the past 30 yr, wells have been drilled at the Hanford Site through these formations in order to:

- Provide water
- Provide quantitative data for evaluating the chemical and physical properties of the underlying material

- Measure hydrologic characteristics of the various aquifers and characterize groundwater chemistry
- Determine engineering design
- Monitor waste disposal facilities
- Monitor the radiological status of the groundwater
- Determine stratigraphy and standard geology.

The Hanford Site water table map (see appendix B) shows the location of some of the wells available for hydrologic measurements.

The aquifers in the Hanford Reservation have been studied extensively using data from existing wells, predictive mathematical studies, and regional hydrologic studies. All these data have been used in preparing the subsequent sections.

5.3.4.2.2 The Unconfined Aquifer. The unconfined aquifer consists of both glaciofluviatile sand and gravel deposits and the Ringold silts and gravels. Since these materials are very heterogeneous, often greater lithologic differences appear within a given bed than between beds (Gephart et al. 1979; Graham et al. 1981). The aquifer bottom is the basalt bedrock in some areas and silt/clay zones of the Ringold Formation in other areas. The impermeable boundaries of the unconfined aquifer within the Hanford Reservation and vicinity are the Rattlesnake Hills, Yakima Ridge, and Umtanum Ridge to the west and southwest. Gable Mountain and Gable Butte, as well as other small areas of basalt outcrop above the water table, also impede the groundwater flow. The Yakima River forms a hydraulic potential boundary which is mainly a discharge boundary for the aquifer. However, the groundwater flow from 1 to 3 mi (1.6 to 4.8 km) inland from the Columbia River is affected by seasonal river stage fluctuations. The flow pattern that originally prevailed in the unconfined aquifer was primarily to the east and northeast with discharge into the Columbia River. Natural recharge occurs at the foot of Rattlesnake Hills and Yakima Ridge. Surface flow sinks into the floor of the valley at the foot of the paralleling Rattlesnake Hills. The underflow is to a great extent interrupted by a buried extension of Yakima Ridge that parallels Rattlesnake Hills at a distance of about 2 mi (3.2 km) and which rises above the water table.

The regional water table is largely within the Ringold Formation and to a lesser extent in the Pasco Gravels. Geologic work has pointed to the existence of highly permeable sediment on portions of both the northern and southern flanks of Gable Mountain. A filled erosional channel extends southeastward from the western side of Gable Mountain toward the permeable zones of the Columbia River.

In 1944, before operations at the Hanford Site began, the hydraulic gradient in all but the southwesternmost portion of the Hanford Reservation was about 5 ft/mi (.9 m/km) (fig. 5-7). Waste disposal at the Hanford Site raised the water table in the recharge sites and altered the existing hydraulic gradient (fig. 5-8). Local groundwater mounds formerly existed at each reactor site along the Columbia River. The mound at the still active 100-N Area is the only one of these remaining. Recharge mounds are found under the Gable Mountain Pond (being decommissioned), U Pond, and B Pond. A minor recharge mound exists under the 300 Area. The differential change in the Hanford Site water table between January 1944 and January 1975 is shown in figure 5-9. A Hanford Site water table map is shown in appendix B.

The natural recharge due to precipitation over the lowlands of the Hanford Reservation is not measurable since the evaporation potential during the summer months greatly exceeds total precipitation. Data on migration of moisture from natural precipitation in deep soils (below 30 ft (9 m)) show movement rates less than 1/2 in/yr (1.3 cm/yr) at one measurement site.

To hydrologically describe an aquifer, four parameters should be considered:

- Hydraulic conductivity: a quantity having the units of velocity that relate the flux of groundwater to the hydraulic gradient
- Aquifer thickness: the thickness of permeable sediment lying between the water table or an upper confining bed and lower confining bed
- Effective porosity: the fraction of porous media capable of transmitting water
- Storage coefficient: the volume of water that a unit decline in head releases from storage in a vertical column of aquifer of unit cross-sectional area.

For an unconfined aquifer, the storage coefficient approaches the effective porosity. Therefore, to describe the unconfined acquifer underlying the Hanford Reservation, measurement is needed of the hydraulic conductivity, aquifer thickness and storage coefficient.

Qualitatively, the hydraulic conductivity and storage coefficient distributions are a function of the different geologic formations in the unconfined aquifer. Ancestral Columbia River channels incised in the Ringold Formation are filled with more permeable glaciofluviatile sediments. Channels of permeable sediments have been identified and are reflected in the groundwater flow pattern of the region.

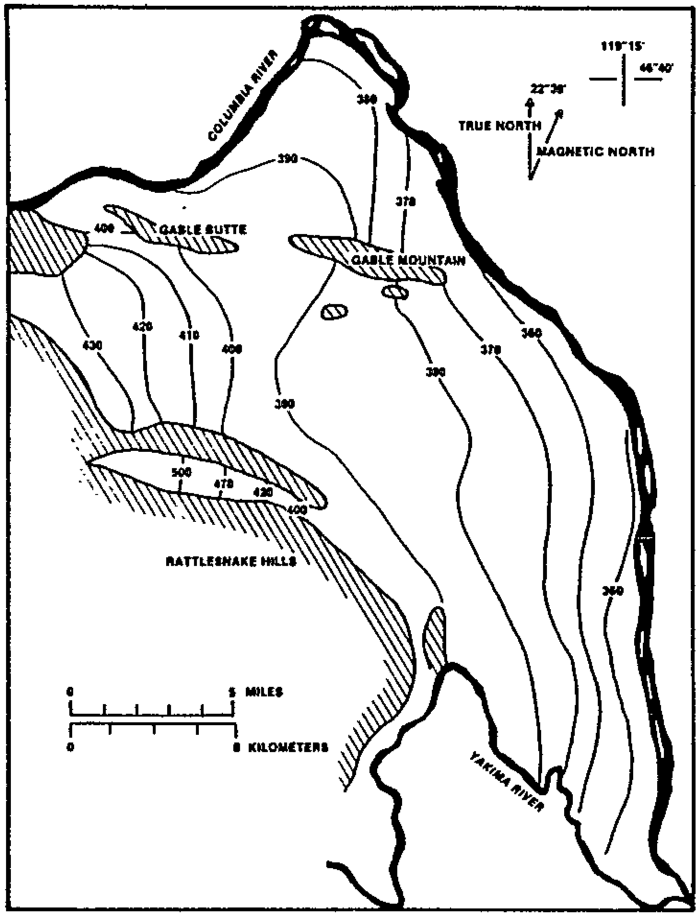


Figure 5-7. Hanford Site Water Table Map, 1944.

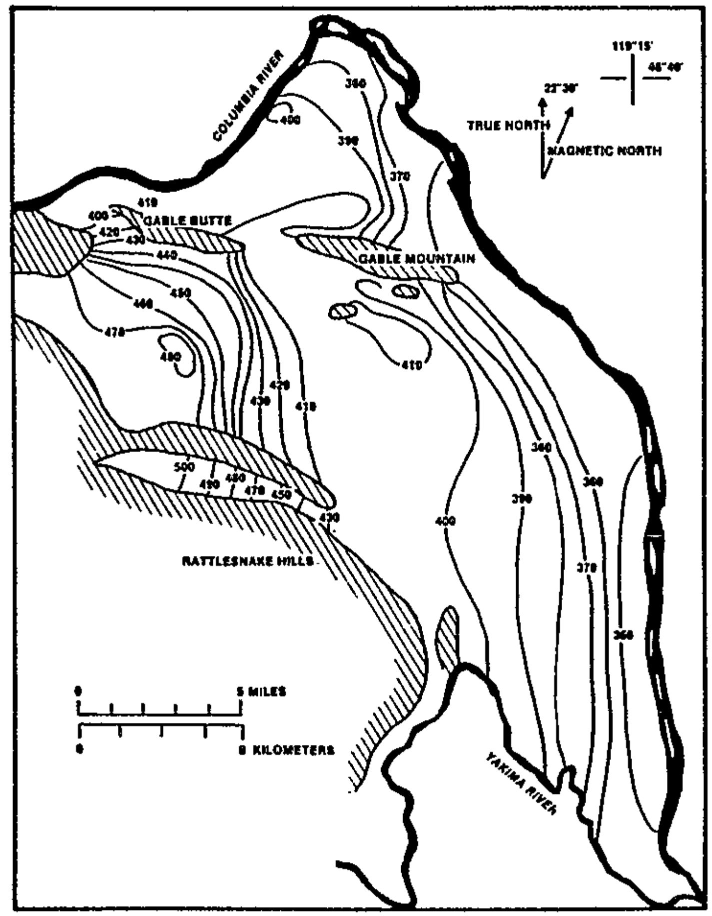


Figure 5-8. Hanford Site Water Table Map, 1978.

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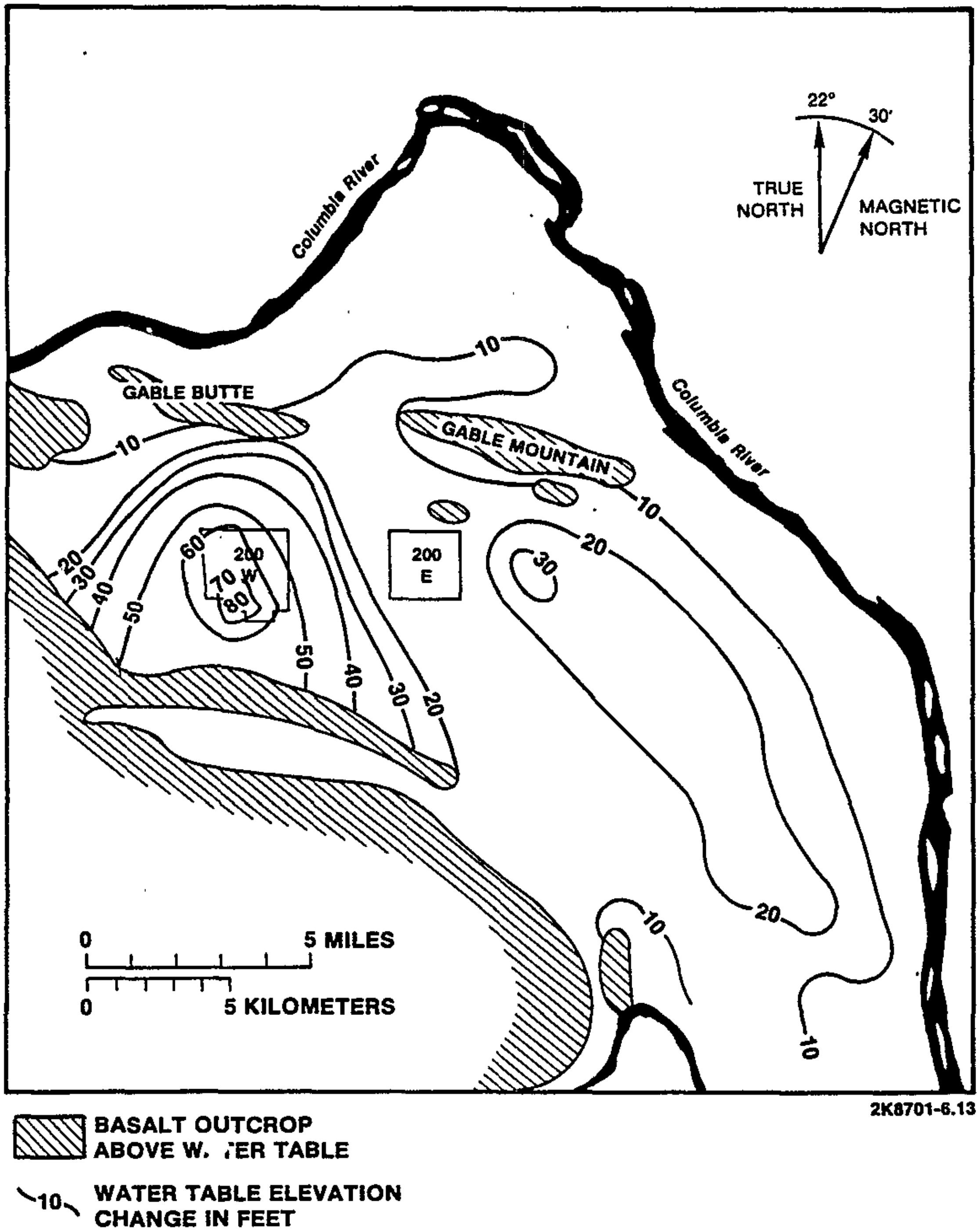

Figure 5-9. Differential Change in the Hanford Site Water Table Between January 1944 and January 1975.

Quantitative measurements of the hydraulic conductivity have been made at several locations over the Hanford Reservation using a variety of techniques (fig. 5-10). Excluding clay zones, the values obtained for the Ringold Formation range from 10 to 7,000 ft/d (3 to 2,100 m/d). Hydraulic conductivities of glaciofluviatile sediments range from 500 to 20,300 ft/d (150 to 6,000 m/d) (Gephart et al. 1979) (table 5-1). The hydraulic conductivity distribution has been obtained using pumping test data and information from driller logs.

Storage coefficient values were measured in the field by using pumping tests. For unconsolidated sediments, the storage coefficient ranges between 0.05 and 0.3. However, few measurements of the storage coefficient have been made to date at the Hanford Reservation. The bottom of the unconfined aquifer has been determined throughout the Hanford Reservation using data from wells. The surface depicting the aquifer bottom corresponds to basalt bedrock in some areas and silt-clay zones of the lower Ringold Formation in other areas. Ultimately, all groundwater in the unconfined aquifer flows into the Columbia River except for that small amount which is lost to the atmosphere by evapotranspiration.

The chemical quality of the groundwater in the unconfined aquifer is measured semiannually at seven locations. Sodium, calcium, and sulfate ions are measured as well as pH. Water from wells in the 300 Area is analyzed for chromium and flouride ions associated with fuel manufacturing operations. Nitrate ion, which is a waste product from the manufacturing and chemical separations operations, is monitored over the entire Hanford Reservation. Maps of the nitrate ion concentration near the water table of the unconfined aquifer are published semiannually.

The temperature of the groundwater in the unconfined aquifer has been measured on an intermittent basis. Local thermal anomalies may be caused by vertical flow within a well casing. In the past, 100 Area reactor groundwater mounds contained water on the order of 160 °F to 190 °F (70 °C to 90 °C.

5.3.4.2.3 <u>The Confined Aquifers</u>. A confined aquifer is one where the water-bearing stratum is overlain and underlain by relatively impermeable beds. Confined aquifers in the Hanford Reservation include (1) permeable sands and gravels in the lower part of the Ringold Formation overlain by thick silts and clays and (2) extensive interflow zones confined by individual basalt flows. The confining beds include sequences of individual basalt flows, where they are continuous and greater than about 50 ft (15 m) thick, and the silts and clays of the lower part of the Ringold Formation. Within the basalt sequence, groundwater is transmitted primarily in the interflow zones, either in sedimentary beds or in the scoria and breccia zones forming the tops and bottoms of the flows. Some of the basalt flows in the Pasco Basin have been eroded, particularly in the anticlinal ridges. In some locations, the basalts are highly jointed and contain breccia, pillow, and palagonite complexes through which groundwater can move. The lower-most Ringold Formation silts and clays are of various thicknesses, and

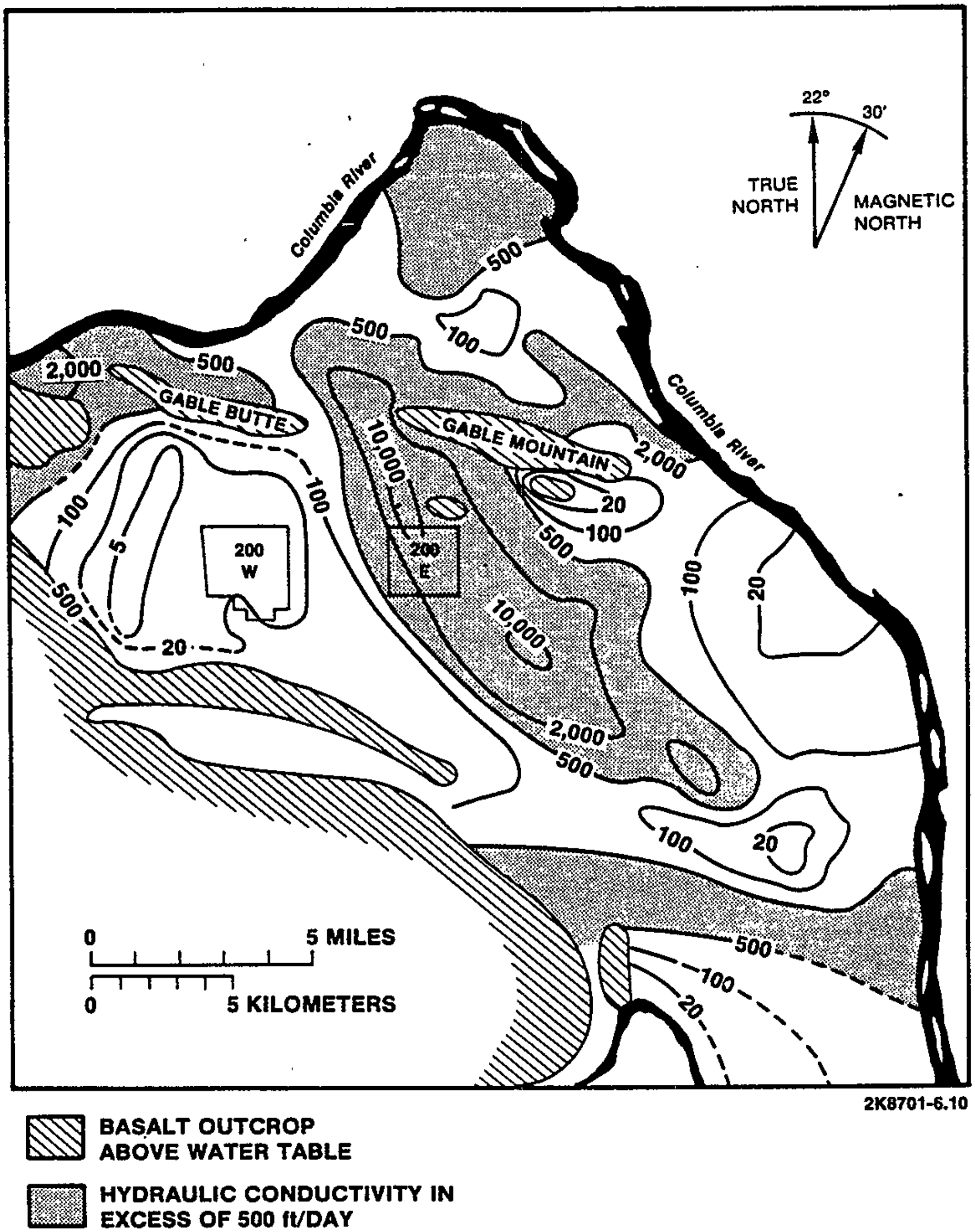

Figure 5-10. Areal Distribution of Hydraulic Conductivity from the Uppermost Aquifer at the Hanford Site.

Table 5-1. Representative Hydraulic Properties in the Uppermost Aquifer.

Stratigraphic interval	Hydraulic conductivity	
	ft/d	m/d
Hanford Formation (informal name)	500 - 20,300	150 - 6,100
Undifferentiated Hanford and Middle Ringold Unit	100 - 7,000	30 - 2,100
Middle Ringold Unit	20 - 600	6 - 180
Lower Ringold Unit	0.1 - 10.0	0.03 - 3.0

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distinct hydraulic potential differences have been observed below the silts and clays. Hundreds of wells on the Hanford Reservation have been drilled to basalt. Most of these wells only barely penetrate the top basalt flows. In general, the hydraulic potential observed in the confined aquifer zones above the basalt is greater than in the overlying unconfined aquifer. However, the flow rates are expected to be quite small due to the low transmissivity range of this water-bearing zone.

In 1970 and 1971, 23 wells penetrating the sands in the lower Ringold Formation and the first few basalt flows and interbeds were pump tested and transmissivity values calculated. From these tests, values of transmissivity ranging between 2 and 8 ft^2/d (.2 and .7 m^2/d) were obtained for the confining beds and values between 50 and 2,000 ft^2/d (4 and 186 m^2/d) for the permeable horizons. The hydraulic conductivity of the confining beds ranges between 0.02 and 0.2 ft/d (.6 and 6 cm/d), and the hydraulic conductivity of the aquifer ranges between 2 and 30 ft/d (.6 and 9 m/d).

Some data on the aquifer properties of the various confined aquifers are available from the Atlantic Richfield Hanford Company deep-drilling project well ARH-DC-1 (fig. 5-11). At this well, the basalt from 362 to 1,200 ft (110 to 366 m) deep has a transmissivity of 695 ft^2/d (65 m^2/d). A sedimentary unit contained in this zone from 830 to 936 ft (250 to 285 m) deep has a transmissivity of 355 ft^2/d (33 m^2/d). A dense basalt zone from 960 to 1,090 ft (290 to 330 m) deep has a transmissivity of 0.2 ft^2/d (.02 m^2/d). There is one significant water-bearing zone, 10 ft (3 m) thick, occurring at 3,230 ft (985 m) deep, with a transmissivity of 68 ft^2/d (6 m^2/d).

Water-bearing sedimentary interbeds are centered at 500, 650, and 900 ft (150, 200, and 275 m) and range from 25 to 100 ft thick (7.5 to 30 m). The bed at 900 ft (275 m) is about 100 ft (30 m) thick consisting of well-sorted medium sand of moderate permeability. Its hydraulic conductivity is about 3.5 ft/d (1 m/d), making it the most productive aquifer penetrated by this well.

5.3.5 Hydrology of the 200 East Area

The hydrologic system in the vicinity of the 200 East Area and the 216-B-63 trench is very complex, and the depth to the water table is on the order of 250 ft (76 m).

The unconfined aquifer beneath the Hanford Site is contained within the Ringold Formation and the overlying Hanford Formation. The unconfined aquifer is affected by disposal of waste water to surface and subsurface disposal sites. The depth-to-ground water ranges from 180 to 310 ft (55 to 95 m) on the 200 Area Plateau. The bottom of the unconfined aquifer is the

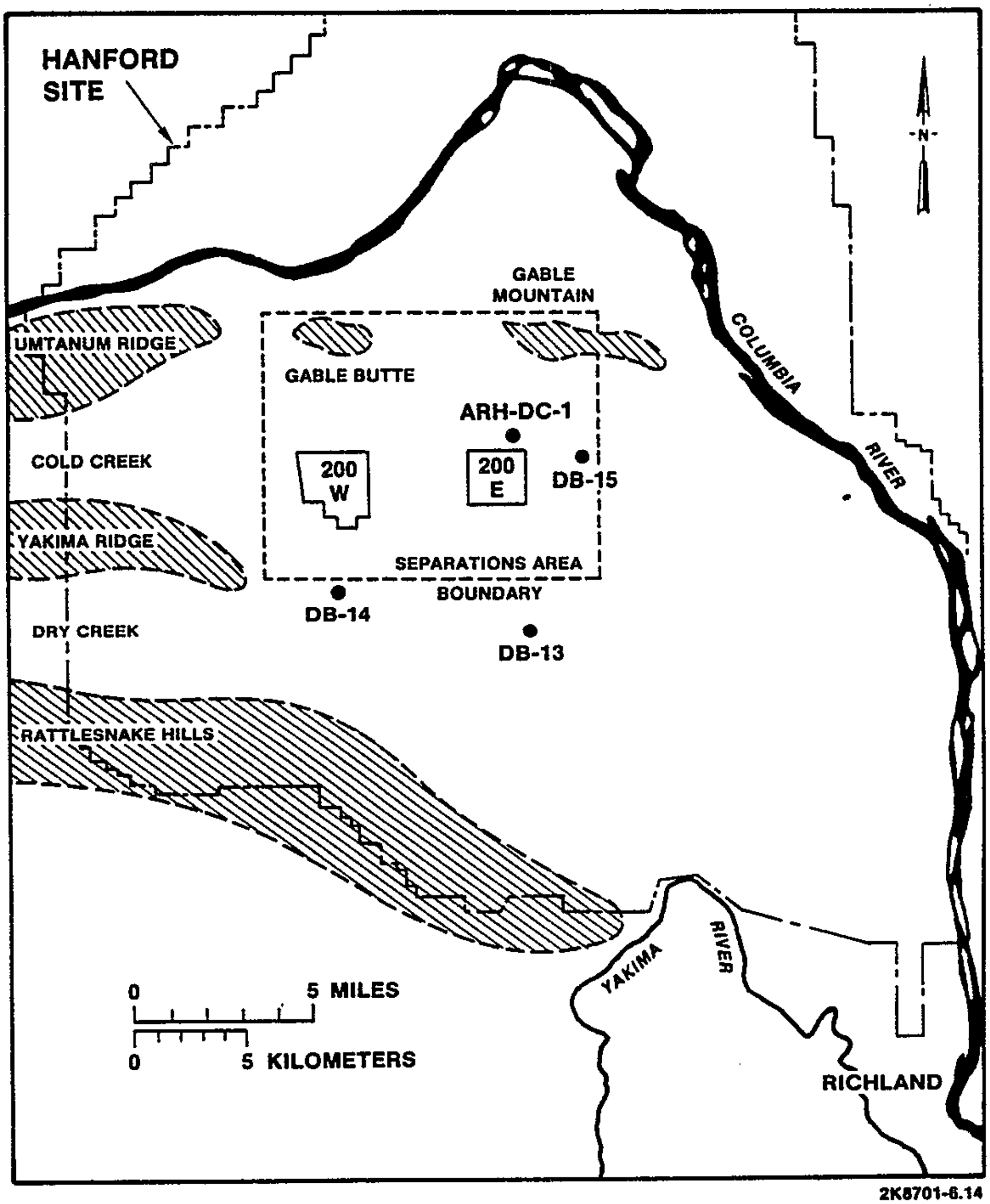

Figure 5-11. Location of Wells DB-13, DB-14, DB-15, and ARH-DC-1.

uppermost basalt surface or, in some areas, the clays of the lower Ringold Formation. The thickness of the unconfined aquifer in the 200 Areas ranges from less than 50 to 200 ft (15 to 60 m). Beneath the unconfined aquifer is a confined aquifer system consisting of sedimentary interbeds or interflow zones that occur between dense basalt flows or flow units.

The sources of natural recharage to the unconfined aquifer are rainfall from areas of high relief to the west of the Hanford Site, and the ephemeral streams, Cold Creek and Dry Creek. From the areas of recharge, the groundwater flows downgradient and discharges into the Columbia River. This general flow pattern is modified by basalt outcrops and subcrops in the 200 Areas and by artificial recharge (see appendix B).

The unconfined aquifer beneath the 200 Areas receives artificial recharge from liquid disposal areas. Cooling water disposed to 200 Area ponds has formed groundwater mounds beneath three high-volume disposal sites: U Pond in the 200 West Area, B Pond east of the 200 East Area, and Gable Mountain Pond north of the 200 East Area. The water table has risen approximately 65 ft (20 m) under U Pond and 30 ft (9 m) under B Pond compared with pre-Hanford conditions (Newcomb et al. 1972). During 1984, U Pond was deactivated and part of Gable Mountain Pond was backfilled in preparation for deactivation (Law and Schatz 1986).

5.4 CONTAMINANT PLUME DESCRIPTION

No Resource Conservation and Recovery Act (RCRA) groundwater monitoring has been conducted at the 216-B-63 trench. Should the proposed groundwater monitoring program, as described in section 5.5, indicate contamination of the groundwater at the facility, further studies will be undertaken to characterize the plume of contamination at that time. This characterization would consider the extent of the plume and the concentration of each hazardous waste constituent.

5.5 GROUNDWATER MONITORING PROGRAM

5.5.1 Purpose

The purpose of this section is to describe a detection-level groundwater monitoring program at the 216-B-63 trench in accordance with the RCRA as described in 40 CFR 265.91 and WAC 173-303-645. The scope for the program includes the characterization of the hydrogeology and the monitoring of groundwater beneath the ponds.

5.5.2 Objectives

Four specific objectives must be met to achieve an adequate RCRA groundwater monitoring system for 216-B-63 trench:

- Determine if hazardous waste constituents from the 216-B-63 trench have entered the groundwater system

- Refine the understanding and knowledge of the hydrogeology of the unconfined aquifer using existing data

- Determine the direction and rate of groundwater flow

- Develop a better understanding of the hydrogeology of the Hanford Formation and the Ringold Formation in the area of the 216-B-63 trench.

5.5.3 Technical Approach

A two-phase approach will be used to meet the objectives discussed in section 5.5.2. Phase 1 will include a detailed review of existing data, determination of well location, drilling of wells, aquifer tests, and refinement of hydrologic and geologic data. Phase 2 will include collection of water-level data over time, design of a sampling system, determination of analyses to perform, and ensuring the adequacy of the new monitoring system. The details of the proposed approach to meet each of the objectives are discussed in detail in the following sections.

5.5.3.1 Phase 1. Phase 1 will consist of reviewing existing data, determining where wells should be drilled, testing each well as it is drilled, and refining the hydrologic and geologic data. Four wells, one upgradient and three downgradient, are planned at this time to comply with State regulations.

Review of data from existing wells, and wells already planned and/or under construction, will be the determining factor in the siting of wells to be drilled. After a well site has been determined and the drilling started, a careful analysis of tne sediments derived from the drilling will be used to determine the potential for downward movement of hazardous contaminants. Specific data will be collected on mineralogy, grain size, and hazardous material concentrations.

All planned wells will be installed using the cable tool drilling method, or other techniques as proven appropriate. The wells will consist of an artificial sand-pack, stainless steel well screen to above the water level, and stainless steel casing to land surface (fig. 5-12). The finished inside diameter of the wells will be ≥4 in (10 cm); figure 5-12 is an

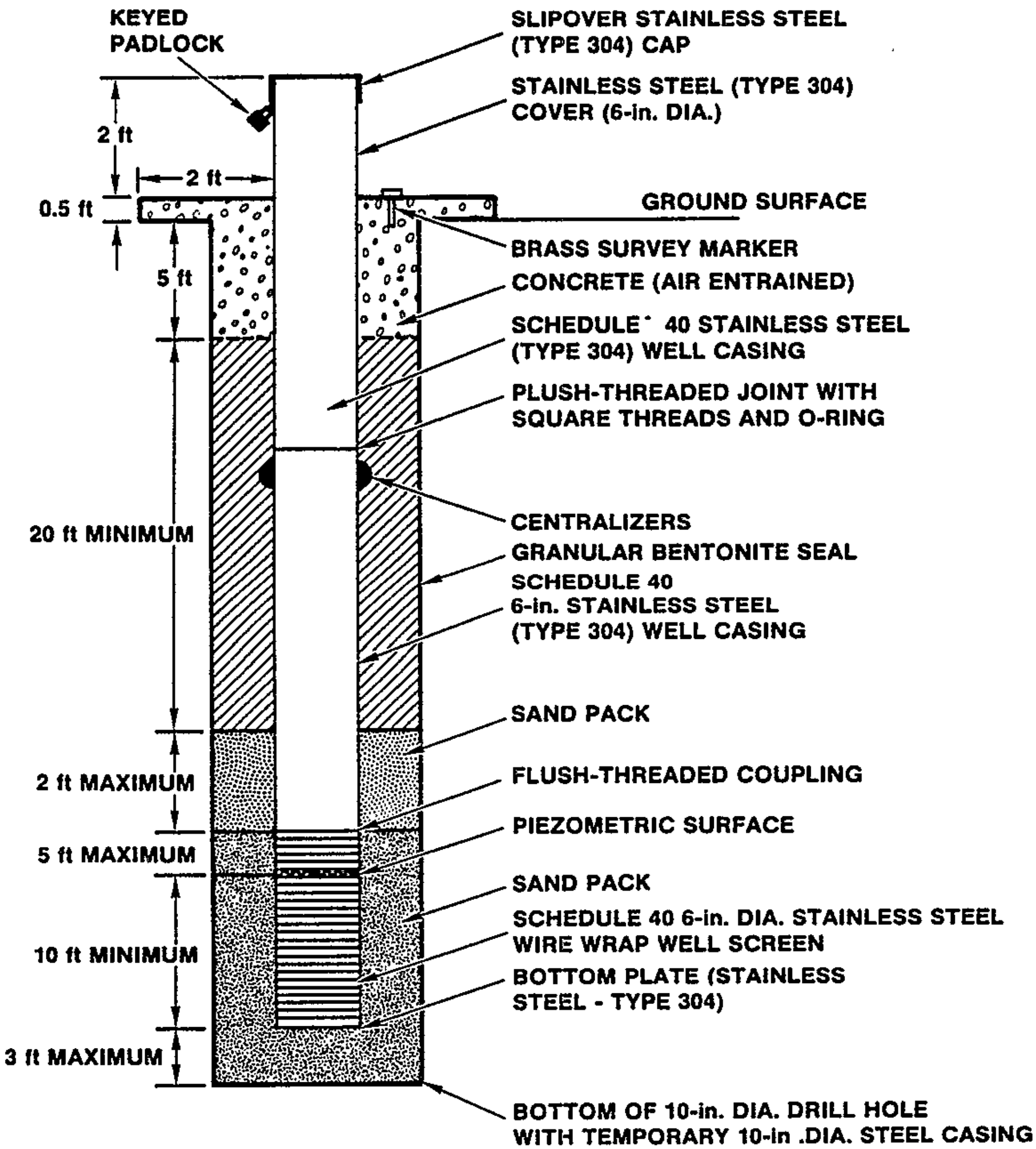

Figure 5-12. Diagrammatic Sketch of Well Structure.

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example of a 6-in. (15 cm) well. Screened intervals will typically be 15 to 20 ft (4.5 to 6 m) with the exact length depending on the thickness of the interval of interest. Drilling equipment, casings, and screens will be steam-cleaned prior to use and kept off the ground as appropriate. Cleanup of drilling and sampling equipment will be performed according to the methods described in section 6.1.4.

Borehole geophysical logs will be made for each well upon reaching final depth and after completion. A qualified geologist will be present during drilling to examine the materials penetrated, prepare geologic logs, oversee the drilling activities, and revise well design if needed. Sediment samples will be collected every 5 ft (1.5 m) and at changes in lithology.

After the completion of the wells, an aquifer test will be performed by pumping the most productive well to obtain the hydrologic characteristics. The remaining wells will be used as monitoring wells during the test. The selection of the pumping well discharge rate, and probable duration of the test will be determined by drawdown tests during well development and bailer tests performed on each well during drilling.

5.5.3.2 Phase 2. Phase 2 will include obtaining water-level data over time, implementing a sampling system, and ensuring the adequacy of the new groundwater monitoring system for the 216-B-63 trench by the use of appropriate statistical methods, modeling, and data review.

Water-level measurements will be taken at the same time water samples are collected. The measurements will be taken with a calibrated steel tape and records kept in a field notebook.

To meet the requirements of a detection-level program, the sampling program will, at a minimum, consist of the following analyses: (1) parameters characterizing the suitability of the groundwater as a drinking water supply, as specified in WAC 173-303-645(5) Table 1 (table 5-2); (2) parameters for establishing groundwater quality, as defined in 40 CFR 265.92(b)(2), Subpart F, viz., chloride, iron, manganese, phenols, sodium, and sulfate; and (3) parameters used as indicators of groundwater contamination, as outlined in 40 CFR 265.92(3), Subpart F, viz., pH, specific conductance, total organic carbon, and total organic halogen. Samples will be collected at least quarterly in the first year and then semiannually through the active life of the trench.

Samples will be collected according to established written procedures as described in PNL-MA-580, Environmental Monitoring Procedures. Water-level measurements will be taken before sampling, and the wells will be purged according to the borehole volume removal procedure. Samples will be collected using dedicated sampling pumps appropriate for the analyses to be conducted.

Table 5-2. Maximum Concentration of Constituents for Ground-water Protection in WAC 173-303-645(5), Table 1.

Constituent	Maximum concentration (mg/L)
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium	0.05
Lead	0.05
Mercury	0.002
Selenium	0.01
Silver	0.05
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.1
Toxaphene	0.005
2,4-D	0.1
2,4,5-TP Silvex	0.01

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Samples will be sealed and transported to the laboratory using the established chain-of-custody procedures as outlined in PNL-MA-580.

Quality assurance/quality control procedures will be the same as those described in the existing groundwater monitoring plans for other Hanford Site facilities (DOE 1986a,b,c).

Methods to be used for sample analysis, sample preservation, and data evaluation are the same as those in the existing RCRA groundwater monitoring plans for other Hanford Site facilities (DOE 1986a,b,c).

5.5.4 Anticipated Deliverables

Interim reports on the results of the characterization work will be produced at the end of Phase 1 and Phase 2. The final report will be compiled at the end of the project. In general, each report will contain: (1) narrative descriptions of the local geologic units and groundwater flow, (2) geologic cross sections, (3) water table maps, (4) geologic and drilling logs, (5) results of the various tests conducted, and (6) analytical results.

5.5.5 Schedule

A definitive schedule for providing characterization monitoring wells is currently being developed. Funding for well drilling has been identified for fiscal year 1988. Additional funding is being pursued for fiscal year 1989. Definitive schedules will be provided immediately upon availability.

5.6 DETECTION MONITORING PROGRAM

A groundwater detection monitoring program will be developed. This program will address:

- Indicator parameters to be sampled for
- A proposed groundwater monitoring system
- Background values for each proposed monitoring parameter
- Groundwater quality at point of compliance (quarterly)

- Groundwater flow rate and direction (annually)
- A description of proposed sampling, analysis and statistical procedures to be utilized in evaluating groundwater monitoring data (PNL 1986).

5.7 COMPLIANCE MONITORING PROGRAM

If the groundwater monitoring data indicates the presence of dangerous constituents in the groundwater at the point of compliance, a compliance monitoring plan will be developed and submitted to the WDOE or EPA for approval as appropriate. This plan will provide:

- A description of the wastes previously handled at the facility
- A characterization of the contaminated groundwater
- A list of constituents that will be monitored (may include part of the WAC 173-303-9905 List)
- Proposed concentration limits for those constituents
- A description of the proposed groundwater monitoring system
- A description of proposed sampling, analysis, and statistical procedures to be used in evaluating groundwater monitoring data (PNL 1986)
- Continual evaluation of the Compliance Monitoring Program and corrective action.

5.8 CORRECTIVE ACTION PROGRAM

If, during the interim status groundwater monitoring program, dangerous constituents are measured in the groundwater in levels which exceed the concentration limits established in WAC 173-303-645(5), Table 1 (see table 5-2), or if the groundwater monitoring program indicates dangerous constituents in the groundwater at the facility boundary over upgradient levels, a corrective action program will be developed to satisfy the requirements of WAC 173-303-645(1).

5.9 REFERENCES

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6.0 CLOSURE AND POST-CLOSURE REQUIREMENTS

The 216-B-63 trench is a facility that received regulated waste in the past. These discharges, originating from B Plant via the B Plant chemical sewer, occurred between 1970 and 1985. Recently, however, high-liquid-level alarms have been installed in the aqueous chemical makeup tanks, corrosive wastes and demineralizer effluents are neutralized prior to release, and the conditions under which releases to the trench can occur are restricted by new administrative controls. Other upgrades currently underway and planned include improved pH monitoring and effluent sampling, and redundant engineered barriers and containment systems at those system components posing the greatest potential for releases under upset conditions. As a result, the 216-B-63 trench currently receives a nonhazardous, nonregulated aqueous solution (for composition of discharge, see section 3.0), and all future discharges to the facility will be nonhazardous.

The purpose of this section is to demonstrate that the DOE-RL is cognizant of the current and past practices relative to the 216-B-63 trench, and that DOE-RL has a plan to administer the unit so that any future releases are within acceptable limits and will not harm the public or the environment. The general closure plan involves several steps, some of which have already been initiated as a demonstration of DOE-RL intent. The general steps are:

(1) Discontinue discharges of hazardous materials to the facility

(2) Sample site soils and sediments

(3) Analyze soil and sediment samples for hazardous components

(4) Close facility under RCRA (inventory removal/decontamination or alternate closure option).

The DOE-RL wishes to make clear that a commitment to close the facility under the RCRA does not necessarily preclude the use of the facility in its current capacity (i.e., as a receiver of nonregulated solutions). The intent of DOE-RL is to operate the facility while establishing that it is not a public or environmental hazard. Should investigation reveal that significant and nonlocalized contamination is present at depth, then DOE-RL will initiate physical closure of the facility or take other appropriate actions that are consistent with RCRA and the Atomic Energy Act. Should these actions become necessary, they will be conducted in accordance with common engineering practices, under the direction of a registered professional engineer and with the approval of the cognizant regulatory authority; i.e., either:

Regional Administrator
Region X
U.S. Environmental Protection Agency
1200 Sixth Avenue
Seattle, Washington 98101

or

Director
Washington Department of Ecology
Mail Stop PV-aa
Olympia, Washington 98504

Details of the 216-B-63 Trench Closure/Post-Closure Plan are presented in the following sections. The locations of official copies of the 216-B-63 Trench Closure/Post-Closure Plan are given in appendix C. The person responsible for storing and updating these copies is presented in appendix D. The certification of closure is provided in appendix E.

6.1 CLOSURE PLANS

6.1.1 Closure Performance Standard

The 216-B-63 trench will be closed in a manner that minimizes further maintenance and the post-closure escape of regulated waste to the extent necessary to protect human health and the environment. If necessary, a cover system will be designed for the facility (see section 6.1.5.2) that will prevent contaminant migration to the groundwater. A cover system will include a vegetative cover that is comprised of perennial grasses which are drought-tolerant and well-suited to the local Hanford Site soils. Revegetation will minimize future maintenance at the site and return the land to the appearance and use of surrounding land areas to the highest degree possible given the nature and extent of the previous dangerous waste activity (section 6.1.5.4).

6.1.2 Partial and Final Closure Activities

The DOE-RL does not anticipate any partial closure activities. Instead, DOE-RL will proceed to final closure of the trench upon approval of this plan. The procedures and methods used to evaluate the facility to determine whether it contains chemical contaminants that are present at hazardous levels will conform to the procedures outlined in EPA SW-846, Test Methods for Evaluating Solid Waste.

Characterization activities leading to final closure will follow a logical progression of increasing detail. Initially, shallow samples of the ditch banks and bottom soil/sediments will be obtained. A random sampling approach will be developed based on the operational history of the ditch and experience gained from other onsite sampling activities. A grid system will be established over the entire site, and sampling points will be determined from random number tables. Samples will be obtained by soil auger (or other suitable method) to a maximum depth of 3 ft ($\sim$1 m) below grade. Samples will be composited from like depths to obtain an understanding of contaminant distribution with depth. A more detailed and comprehensive characterization plan will be prepared for submittal to the appropriate regulatory authorities prior to initiating the actual characterization (sampling and analysis) activities.

Throughout the sampling effort, a field log book will be maintained. All information pertinent to the sampling will be recorded in the log in sufficient detail to allow someone to reconstruct the sampling without relying on the collector's memory.

The sample containers will be compatible with the waste, sufficiently durable to withstand handling and transport, and large enough to contain the optimum sample volume. Although sample analyses will be performed as soon as possible after sampling, appropriate steps will be taken to preserve the physical and chemical integrity of the sample during transport and storage prior to analysis. The method of sample preservation used will be based on the sample type and the analytical method to be employed. The analytical parameters will be based on the composition of the ditch influent and known receipts of characteristically hazardous waste (described in section 3.0).

The integrity of the samples will be ensured from collection to data reporting through appropriate chain-of-custody procedures. Labels will be affixed to each sample container and filled out at the time of collection. Sample label information will include the sample number, name of the collector, and the date, time, and location of collection. Sample seals used to detect unauthorized tampering will contain the same information as the sample label. Chain-of-custody records will also accompany each sample to document possession from the time of collection.

Background samples will also be obtained from selected locations surrounding the trench to establish background concentrations for the hazardous characteristics or constituents of concern. Background samples will be taken from areas unaffected by past operations at the site, and from geologic strata and depths similar to the samples obtained from the trench. All data generated by the sampling and analysis effort will be evaluated and retained.

This evaluation will serve as the basis for a preliminary technical assessment to determine appropriate cleanup levels and evaluate remedial action alternatives. The assessment will be based on, and be consistent with, the Washington Department of Ecology's Final Cleanup Policy-Technical (July 10, 1984) and other RCRA requirements.

6.1.3 Maximum Waste Inventory

The 216-B-63 trench is known to have received hazardous wastes originating from B Plant via the B Plant chemical sewer. Although post-November 1980 hazardous waste discharges to the trench are well known and documented, comparable information on similar releases occurring before that time is much less complete. As a result, the chemical inventory of the trench is currently unknown and will have to be determined by sediment and core sample analysis during the course of the characterization activity. Once the maximum waste inventory has been determined, it will be reported to the appropriate regulatory authority.

6.1.4 Inventory Removal, Disposal or Decontamination of Equipment

If contamination is found and determined to be extensive both areally and at depth, decontamination or inventory removal may be impractical. Should such conditions be found to exist, DOE-RL will initiate physical closure or other appropriate actions that are consistent with RCRA. If physical closure is deemed necessary, a final cover will be constructed as described in section 6.1.5.2.

If contamination above acceptable levels is found and determined to be relatively shallow and localized, it will be removed. The depth and extent of removal will be based on the analytical results of the sampling and characterization activity discussed in section 6.1.2. The success of the decontamination effort (i.e., inventory removal) will be based on the technical assessment and determination of appropriate cleanup levels as discussed in section 6.1.2 for the hazardous characteristics or constituents of concern. Post decontamination detection above the appropriate cleanup levels will necessitate further decontamination of the affected area. Once the levels are achieved, no further sampling and analyses will be required and decontamination efforts will cease. The sampling schemes and analytical methods applied to evaluate the characteristics or constituents of concern will conform to those contained in SW-846.

Should it be necessary to decontaminate portions of the trench, this decontamination effort will result in the generation of hazardous or dangerous (i.e., regulated wastes requiring treatment and/or disposal. All regulated wastes generated by the decontamination effort will be containerized in plastic-lined, U.S. Department of Transportation-specified, 55-gal drums, or packaged in bulk according to procedures submitted to the appropriate regulating agencies for prior approval. All regulated wastes will be manifested and processed through the onsite Nonradioactive Dangerous Waste Storage Facility for shipment to an approved treatment and/or disposal unit. Radioactive waste will be processed and packaged for disposal in accordance with current practices.

It will be assumed that all tools and equipment used during the decontamination effort are contaminated with regulated waste. All reusable equipment will be washed or steam-cleaned in a designated area prepared to contain all residues generated during the cleaning process. Swab samples of the cleaned equipment and a representative sample of the cleaning residue will be analyzed for identified characteristics or constituents of concern and compared against the established cleanup values.

Successful equipment decontamination will be based on nondetection or a determination that the hazardous constituent concentrations are below the previously established cleanup levels. Equipment not meeting this criterion will undergo further decontamination and sampling verification. Cleaning residues will be judged against the same criterion. Any nonradioactive residues determined to be regulated will be prepared for processing through the onsite Nonradioactive Dangerous Waste Storage Facility. Similarly, all other nonradioactive materials deemed regulated (e.g., plastic liner for decontamination residue containment and collection) will be appropriately packaged and processed for treatment and/or disposal at an approved facility. Radioactively contaminated materials will be disposed of consistent with current accepted practice.

The tools and equipment potentially used in the decontamination and/or final closure efforts include:

- Protective clothing
- Adhesives (tape and cements)
- Inert absorbent materials
- Drum-handling equipment
- Miscellaneous hand tools
- Rags and plastic materials
- Waste containers
- Solidifying agents

- Sampling tools and containers
- Heavy equipment.

Monitoring of employee exposure to hazardous chemicals, personal protection equipment, medical surveillance, record keeping, and health and safety requirements will be determined by the appropriate safety organization in accordance with 29 CFR 1910 and other DOE guidance.

6.1.4.1 Closure of Containers. This section is not applicable to 216-B-63 trench.

6.1.4.2 Closure of Tanks. This section is not applicable to 216-B-63 trench.

6.1.4.3 Closure of Waste Piles. This section is not applicable to 216-B-63 trench.

6.1.4.4 Closure of Surface Impoundments. This section is not applicable to 216-B-63 trench.

6.1.4.5 Closure of Incinerators. This section is not applicable to 216-B-63 trench.

6.1.4.6 Closure of Land Treatment Facilities. This section is not applicable to the 216-B-63 trench.

6.1.5 Closure of Disposal Units

If hazardous constituents are determined to be present at concentrations or depths that render inventory removal impractical, then DOE-RL will initiate physical closure of the facility or take other appropriate actions that are consistent with RCRA and the Atomic Energy Act. If a determination for final closure is made, the final cover and its expected performance are described in section 6.1.5.2.

6.1.5.1 Disposal Impoundments. No preparation of the wastes is expected to be required should it be necessary to close the 216-B-63 trench as a disposal unit.

6.1.5.2 Cover Design. If the characterization activity indicates the presence of shallow and/or localized contamination above acceptable levels, it will be removed. As a result, no cover will be required. However, if deep, significant, and/or extensive contamination renders inventory removal impractical, then a final cover may be required, such as that described in the following sections, may be constructed.

6.1.5.2.1 Final Cover General Design Description. A multilayer cover may be used for closure of the 216-B-63 trench. The primary objective of a cover system design is prevention of water infiltration into underlying waste zones where contact may leach contaminants into the groundwater. The cover will consist of 4-ft (1.2-m) deep soil, revegetated and underlain by a woven synthetic geotextile fabric and 6 in. (15 cm) of gravel. The 4-ft (1.2 m) depth of soil will provide storage for annual precipitation and support the establishment and growth of a perennial grass cover that will stabilize the surface and enhance soil-water removal. The geotextile will minimize the sifting of fines into the gravel interstices. The gravel layer will serve as a capillary barrier between the cover soil and waste zone, increasing the amount of water storage potential in the upper soil layer and maintaining greater levels of plant available moisture.

6.1.5.2.2 Concept and Function of the Multilayer Cover. Soil water moves in response to pressure head differences. The pressure heads are positive in saturated soils because of hydrostatic forces and negative in unsaturated soils because of capillary forces. In unsaturated soil, water movement is influenced both by capillary forces and by gravity. For relatively salt-free soils, the combination of capillary and gravitational heads determines the total hydraulic head, usually expressed in terms of length (centimeters or meters) of an equivalent water column. Infiltration into either uniform or layered soils can be predicted by properly characterizing the gradient of hydraulic head and hydraulic conductivity. Another simple, yet basic, soil water concept is the soil water outflow law (Richards 1950). This law states that water will not move from soil into an open cavity until the water pressure is atmospheric or greater. For layered soils, this means that water will not move from fine soil into very coarse soils until the soil at the boundary between the soil layers is virtually saturated (i.e., until the water pressure (capillary pressure) in the fine soil at the boundary is near or equal to zero). This basic law is fundamental to understanding the concept of a multilayer barrier.

The final cover intended for use at the trench is based on the soil water outflow law just described. The gravel layer underlying the cover soil serves as a capillary barrier. As moisture infiltrates the cover soil, a wetting front moves downward through the soil of relatively fine porosity to the point of contact with the large-pored (gravel) layer. The volume of pores capable of holding water at the tensions that exist at the wetting front and water-filled cross section is reduced. Before the wetting front can advance, the soil water pressure at that point must increase until it is large enough to allow the pores to fill with water. The overlying soil will retain considerably more water at this point than would the same soil depth if a coarse (gravel) layer had not been present.

6.1.5.2.3 Fine Soil for Final Cover. In order for a multilayer cover to be effective in eliminating drainage, it must be capable of storing at least the anticipated annual precipitation and, preferably, the maximum expected amount. The greatest amount of annual precipitation recorded at

Hanford to date is approximately 11 in. (28 cm). There is a greater than 95% probability that the 11-in. (28-cm) total will not be exceeded (fig. 6-1). This amount of precipitation has been established as a design criterion.

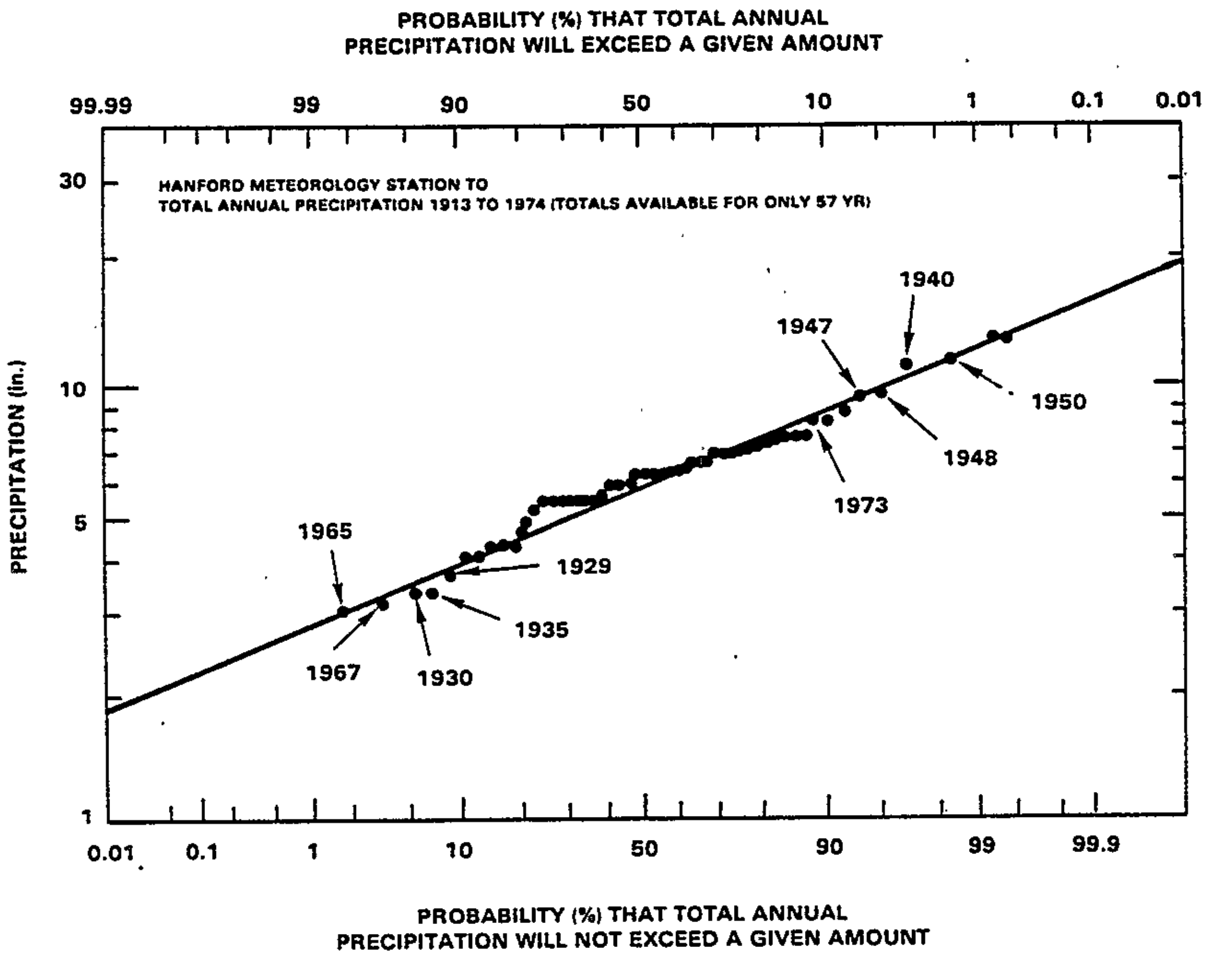
To meet the criteria of higher water-holding capacity and less permeability, the final cover soil will have to be obtained from selected sites outside of the immediate areas surrounding the pond. The most promising soil identified thus far belongs to the Esquatzel series. Esquatzel-series soils are typically deep and medium-textured, and exhibit moderate permeability and high water-holding capacity. Relatively uniform deposits of this soil type have been located approximately 2 mi (3 km) west of the 216-B-63 trench; however, further investigations and soil analyses are planned to locate a source of suitable materials as near to the pond as possible.

In lieu of detailed soil data, the Benton County Soil Survey was used to obtain estimated properties of the Esquatzel-series soils. These estimated properties are as follows:

- Textural class: fine sandy loam
- Unified class: ML
- Permeability: 0.8 to 2.5 in/h (2.0 to 6.3 cm/h)
- Water-holding capacity: 0.16 to 0.20 in/in (cm/cm) of soil (0.40 to 0.50 cm/cm of soil).

Based on the estimated minimum water-holding capacity of 0.16-in. water/in. soil (cm/cm), a nonlayered, 4-ft-deep (1.2-m) soil profile will retain 7.8 in. (20 cm) of water. However, as discussed in more detail in section 6.1.5.3, the water-holding capacity of a sandy loam soil underlain by coarse material (i.e., a capillary barrier) can be increased by a factor of at least 1.5. Applying this factor to this 7.8-in. (20 cm) minimum-water-holding capacity, results in a total potential water-holding capacity of 11.7 in. (30 cm), or nearly 1 in. (2.5 cm) more than the maximum-recorded amount of precipitation at the Hanford Site.

6.1.5.2.4 Gravel for Final Cover. Materials ranging in size from coarse, washed sand to cobble-sized rock could be used to achieve the textural change necessary for the capillary barrier; however, 1/4- to 1/2-in. (6 to 12 mm) gravel is easily handled and provides a stable base over which the remainder of the barrier can be constructed. This size gravel is available onsite at the excessed concrete batch plant, or can be obtained from numerous sources offsite. The thickness of the gravel or capillary barrier will be at least 6 in. (15 cm). Barrier experience gained thus far has shown that this is the minimum thickness obtainable by use of heavy equipment during construction.



REFERENCE: FINAL ENVIRONMENTAL STATEMENT ERDA-1538. WASTE MANAGEMENT OPERATIONS, HANFORD RESERVATION, RICHLAND, WASHINGTON P.II.3-E-33

2K8509-3.20

Figure 6-1. Total Annual Precipitation Probability Diagram.

6.1.5.2.5 Geotextile for Final Cover. The distinctness of the textural change between the soil and the gravel layer will be maintained by use of woven synthetic geotextile fabric. The geotextile is commonly used for load distribution and subgrade stabilization during roadway construction and offers excellent resistance to installation abuse. The product chosen is manufactured by Mirafi Construction Fabrics (Product No. 600X) and exhibits the tested properties indicated in table 6-1. This product has been used in previous barrier construction at the Hanford Site to prevent soil fines from sifting into underlying gravel layers. This experience should prove useful during construction of the final cover at the ditch.

6.1.5.2.6 Vegetative Cover. Having established the ability of the final cover to safely store maximum annual precipitation, a mechanism for removal of the stored soil water must be provided. While estimates of annual evaporation closely approximate annual precipitation, these estimates relate more accurately to total potential evaporation. Evaporation does account for the majority of the soil water removed; however, its effectiveness diminishes with soil depth.

To prevent the eventual accumulation of moisture and the possibility of drainage through the capillary barrier, a vegetative cover will be established to enhance soil water removal. This vegetative cover will be comprised of Siberian wheatgrass (Agropyron sibericum) and thickspike wheatgrass (Agropyron dasytachyum), both of which have been used routinely with good success at the Hanford Site. These species are drought-tolerant and well-suited to the medium- to coarse-textured local soils.

Once established, the vegetative cover will assure effective removal of available moisture (i.e., water held at less than -15 bars) throughout the 4-ft (1.2-m) deep soil layer. The soil layer depth is sufficient to support and contain the rooting depth of the intended plant cover, and similar plant covers are known to be effective in exploiting soil water to depths of at least 4 ft (1.2 m). Plant root penetration into the gravel layer is not expected to occur because of the gravel pore size and resultant lack of available moisture.

6.1.5.3 Minimization of Liquid Migration. Most cover designs typically rely on impermeable barriers. An impermeable barrier as envisioned by the EPA at the present time would consist of clay and/or a synthetic liner. However, research on barriers has shown that multilayer cover systems are effective in minimizing and preventing liquid migration into a buried waste zone in arid environments (Bone and Schruben 1984; Winograd 1981). Multilayer systems can use the natural material of rock and soil to provide a durable and long-lasting cover system that will fulfill the intent of the regulations, which is to prevent the entry of liquids into the closed waste confinement area.

Table 6-1. Properties of Mirafi Geotextile.

600X fabric	Unit	Test method	Typical values
Grab tensile strength	lb	ASTM D-1682-64	300 (135 kg)
Grab tensile elongation	%	ASTM D-1682-64	35 (maximum)
Burst strength	lb/in^2	ASTM D-3786-80	600 (42 kg/cm^2)
Trapezoid test strength	lb	ASTM D-1117-80	120 (54 kg)
Puncture resistance	lb	ASTM D-3787-80	130 (59 kg)

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The basis for the multilayer approach is the soil water outflow law, which states that water will not move from a fine-pored soil into much larger pores until the water pressure is atmospheric or greater. For layered soils, this means that water will not move from fine soil into very coarse soils until the soil at the boundary between the soil layers approaches saturation. Field observations of layered soils indicate that significant increases in soil water storage can be attained when soils are underlain by coarse-textured materials. This is particularly true when the soil is moderately fine-textured. Table 6-2 (from Miller 1973) shows the effect of layering on water storage in an overlying soil.

The greater water retention is attributed to the textural differences between the upper soil and capillary barrier. The coarser the underlying material, the less flow is expected until nearly saturated conditions prevail. The effectiveness of the multilayer cover to prevent or minimize liquid migration will thus be ensured by:

- Highly nonlinear nature of unsaturated hydraulic conductivity across the fine soil/coarse gravel interface
- Water-holding capacity of the final cover soil
- Evapotranspiration of accumulated soil water.

The soil of the multilayer cover system is a fine sandy loam. As a textural class, sandy loam is intermediate between loam and loamy sand. From table 6-2, it can be inferred that moisture retention in a sandy loam soil underlain by coarse material (i.e., a capillary barrier) can be increased by a factor of at least of 1.5. As stated previously in section 6.1.5.2, a nonlayered, 4-ft-deep (1.2 m) sandy loam soil profile will hold 7.8 in. (20 cm) of water, which is 2 in. (5 cm) more than the average annual precipitation and 3 in. (8 cm) less than the maximum recorded precipitation. Utilizing this inferred increase in moisture retention capacity attributable to the presence of a capillary barrier, the estimated 7.8 in. (20 cm) total water retention capacity is increased to 11.7 in. (30 cm). Referring to figure 6-1, the probability that annual precipitation will exceed this amount is estimated to be less than 1%. Further, assuming that evapotranspiration equals precipitation, the probability that precipitation will be great enough to penetrate the multilayer barrier can be estimated to be less than 1%.

6.1.5.4 <u>Maintenance Needs</u>. Experience gained from Hanford Site stabilization since 1978 (approximately 800 acres) has shown that very little maintenance is required following the successful establishment of the vegetative cover. Successful establishment generally requires from 2 to 3 yr. During this period, the straw mulch applied for initial stabilization and the natural emergence of cheatgrass (Bromus tectorum), which is ubiquitous in southeastern Washington, combine to protect the soil cover

Table 6-2. Water Retention in Layered Soil Properties.

Soil material	Stored water[a] Texture		
	Loamy sand	Loam	Silt loam
Soil underlain by sand layer (at 60-cm depth)	16.4 (3.3 in/ft)	17.4 (3.5 in/ft)	20.0 (4 in/ft)
Uniformly deep soil with no layer	6.7 (1.3 in/ft)	11.4 (2.3 in/ft)	16.7 (3.3 in/ft)
Ratio layered/uniform	2.5	1.5	1.2

[a]Cm water/60-cm soil.

PS187-3144-1

from erosion by wind. Also, qualified personnel periodically evaluate seedling progress and recommend any necessary corrective actions. Herbicides are often used in the spring to selectively control annual broadleaf species that compete for available moisture and nutrients. Herbicide applications can be discontinued following successful perennial grass establishment.

Fertilizer applications are sometimes needed after closure to stimulate plant vigor during the second or third year. Some instances of apparently increased rodent activity have been discovered, primarily in the form of burrows in the cover side slopes. This potential problem has been practically eliminated by decreasing the side slope angles to 3-to-1. The only other maintenance resulting from periodic surveillance has been the manual removal of deep-rooted shrubs that might penetrate the underlying waste zone. No additional backfilling has been required as a result of wind or water erosion. Maintenance of the final cover is not expected to be dissimilar from that experienced to date on other Hanford Site stabilization projects.

6.1.5.5 Drainage and Erosion. No artificial drainage will be incorporated into the final cover system. Soil permeability and typical rainfall intensities are such that water erosion has not been a problem at the Hanford Site. The greatest potential for erosion arises in the late winter when rapid snow melts might occur over frozen ground. No significant erosion has been recorded during routine surveillance of areas stabilized to date.

Initial erosion/abrasion protection will be provided by the application of a straw mulch. The entire cover and surrounding area disturbed during construction will be mulched at a rate of approximately one ton of straw per acre. Mulching is an integral part of the revegetation process at Hanford and it has proven very effective in minimizing seedling damage and soil loss by winds. Once established, the perennial grasses will provide the protection necessary to minimize erosion over the long term. Little erosion has been recorded on other areas (800 acres (324 ha)) stabilized to date.

6.1.5.6 Settlement and Subsidence. Localized settlement should not prove detrimental to the integrity of the multilayer cover and there is no reason to expect anything more than minor differential settlement of the backfill materials. Additionally, the geotextile will lend some support to the soil cover by providing load distribution over the area being closed. Nevertheless, subsidence will be monitored through periodic surface measurements taken from permanent benchmarks and concrete perimeter posts. Possible maintenance actions are contained in the post-closure plan (section 6.2).

6.1.5.7 Cover Permeability. Since no bottom liners (clay or synthetic) have been used at the trench, the final cover system permeability need only be less than that of the underlying native soil. In lieu of detailed soils data, the Benton County Soil Survey was used to obtain estimated properties for Quincy series soils that correlate very closely to the Rupert series encountered at the trench. These estimated properties are as follows:

- Textural class: loamy sand
- Unified class: SM
- Permeability: >10 in/h (>25 cm/h)
- Water-holding capacity: 0.03 to 0.05 in/in (cm/cm) soil.

Referring to the estimated properties presented earlier for the Esquatzel series soils, the final cover soil has an estimated permeability of 0.8 to 2.5 in/h (2.0 to 6.3 cm/h) compared to greater than 10.0 in/h (greater than 25 cm/h) for the underlying native soil. Therefore, the permeability of the final cover soil (excluding the retarding effect of the cover system) is much less than that of the native soils beneath the pond.

6.1.6 Continuance of Operations

Final closure may require that sediments be removed from only a portion of the trench. Should this be the case, the outfall may be permanently relocated or temporarily diverted to unaffected portions of the trench until all contaminated sediments have been removed. Throughout this time, groundwater monitoring will continue as described in section 5.0.

6.1.7 Schedule for Closure

All regulated waste will be removed within 90 d of initiating closure, and final closure will be complete within 180 d, subject to section 6.1.8. If a cover system is necessary, a detailed schedule for construction will be submitted to the appropriate regulatory authorities.

6.1.8 Extensions for Closure Time

If, before or during the start of the trench closure operations, it appears that closure may take more than 180 d, a petition will be made to the appropriate regulatory authority to extend the 180-d closure time. An extension may be required if initial sampling and analysis indicates that pond contamination is extensive, or that further sampling/analysis and the removal of all contaminated soil will take longer than the currently anticipated 180-d closure time.

6.2 POST-CLOSURE PLAN

If contamination significantly exceeding the established cleanup levels is found at depth, the trench will be closed in place and the following post-closure plan will be implemented.

6.2.1 Inspection Plan

An engineer or scientist with experience in the construction and function of a multilayered cover system will perform the following monitoring activities semiannually for the first 5 yr and annually for the remainder of the post-closure period:

- Evaluation of settlement/subsidence
- Evaluation of vegetative cover
- Evaluation of bench marks
- Evaluation of rodent intrusion
- Evaluation of erosion.

The indicated frequency of inspection is expected to be adequate to detect any serious problems with the cover system.

Maintenance action will be initiated within 90 d if the inspection reveals that the integrity of the final containment structure can potentially be breached. Potential breaches and possible maintenance actions are defined as follows.

- Settlement/subsidence greater than 18 in. (0.5 m) will initiate maintenance action. Maintenance action may include injecting a grout into identified void spaces and reestablishing the integrity of the multilayer cover system; or stabilizing the settlement/subsidence area and relaying the multilayer action over the affected area. If, at the time of maintenance action, products and/or information is available to perform the needed repair in a comparable manner to the actions listed above, those maintenance actions may be considered in lieu of the above proposed actions.

- Vegetative cover less than 10% after 2 yr of closure will initiate maintenance action. Maintenance action will include reseeding and possible fertilizer application.

- Bench marks observed to be damaged or out of alignment will result in maintenance action. Maintenance action will include replacement and resurveying of bench marks found to be damaged or out of alignment.

- Rodent intrusion in densities that are judged to threaten the integrity of the multilayered system will result in maintenance action. Maintenance action might include the use of chemical deterrents and/or trapping.

- Erosion damage that results in the loss of 18 in. (0.5 m) of the fine soil top layer will result in maintenance action. Maintenance action will include replacement of the fine soil at the affected area, reseeding, and performing other selected tasks that were performed during closure to ensure a vigorous vegetative growth.

6.2.2 Monitoring Plan

During the post-closure care period, groundwater monitoring will be conducted as described in section 5.0. There are no liners or leachate collection and removal systems at the 216-B-63 trench. All groundwater monitoring wells for the ditch are within a secured area of the Hanford Site. All wells will be routinely inspected to ensure proper operation.

6.2.3 Maintenance Plan

During the post-closure care period, the maintenance operations are directed at maintaining the integrity of the waste containment system. Containment system experience since 1978 has shown that such containment systems will remain intact if the vegetative cover is successfully established. Invading plants, primarily Russian thistle (Salsola kali), with root systems that can extend into waste zones, pose the greatest potential problem. The active elimination of these invading species for 2 to 3 yr after seeding generally allows the vegetative cover enough time to become firmly established.

For 2 to 3 yr following closure, selective herbicides will be applied to the closure area to minimize the establishment of deep rooting, annual, broadleaf plants that compete with the grasses for moisture and nutrients. Selective herbicide applications can be discontinued following successful establishment of the perennial grass cover. Following establishment of the selected grass cover, manual removal of deep rooting shrubs may be periodically required.

Soil permeabilities and rainfall intensities at the Hanford Site are such that water erosion has proven to be practically nonexistent. However, the potential for wind erosion is possible, particularly during the period of vegetative establishment. Current mulching practices, which will be implemented during closure, have been very effective at minimizing wind erosion. To date, there has been no need to import or provide additional backfill as a result of erosion.

Maintenance of bench marks has not been a problem to date. Vegetation typical of the arid Hanford Site environment is sufficient to prevent drifting sand from overrunning or obscuring the bench marks, and small enough in stature to permit easy observation. However, if a bench mark becomes physically damaged and needs to be replaced, that action will be completed within 90 d of the original observation.

6.2.4 Land Treatment

This section is not applicable to the 216-B-63 trench.

6.3 NOTICE IN DEED

6.3.1 Notice to Local Land Authority

The DOE-RL will file, within 90 d after the start of the post-closure care period, the following documents or similar documents to the local land use authority and the regulating authority. The land use authority is the Benton County Planning Department located at the Courthouse Building, Prosser, Washington, 99350.

(a) A survey plat indicating the location and dimensions of the ditch to the extent the information exists and with respect to permanently surveyed bench marks will be submitted. This plat will be prepared by a certified professional surveyor.

(b) The following note is to accompany the survey plat:

This plat describes real property in which hazardous wastes have been disposed and buried in accordance with requirements of 40 CFR Part 264 and/or WAC 173-303. Although this hazardous waste disposal facility is now closed, public health, environmental safety, and regulations issued by the EPA in 40 CFR 264.119 and/or WAC 173-303-610(9) require that post-closure use of the property never be allowed to disturb the integrity of the final cover unless it can be demonstrated that any proposed disturbance will not increase any risk to human health or the environment.

(c) A record of the type, location, and quantity of hazardous wastes disposed of within the pond to the extent that the information exists will be submitted. During the post-closure this record will be submitted to the regulating authority.

6.3.2 Notice in Deed to Property

The DOE-RL will, in accordance with the state law, sign, notarize, and attach the following notation to the deed of the 216-B-63 trench area within 180 d of the start of the post-closure care period:

TO WHOM IT MAY CONCERN

The U.S. Department of Energy-Richland Operations Office, an operations office of the U.S. Department of Energy, which is a department of the United States Government, the undersigned, whose local address is the Federal Building, 825 Jadwin Avenue, City of Richland, County of Benton, State of Washington, hereby gives the following notice as required by 40 CFR 265.120 and/or WAC 173-303-610(10):

(a) The United States of America is, and since April 1943, has been in possession in fee simple of the following described lands (legal description).

(b) Since November 19, 1980, the U.S. Department of Energy-Richland Operations Office has disposed of hazardous and/or dangerous waste under the terms of regulations promulgated by the United States Environmental Protection Agency and/or Washington Department of Ecology to the above-described land.

(c) The future use of the above-described land is restricted under the terms of 40 CFR 264.117(c) and/or WAC 173-303-610(7)(d).

(d) Any and all future purchasers of this land should inform themselves of the requirements of the regulations and ascertain the amount and nature of wastes disposed on the above-described property.

(e) The U.S. Department of Energy-Richland Operations Office has filed a survey plat with the Benton County Planning Department and with the United States Environmental Protection Agency Region 10 and/or Washington Department of Ecology showing the location and dimensions of the 216-B-63 trench and a record of the type, location and quantity of waste disposed within the area of the trench.

6.4 CLOSURE COST ESTIMATE

This section is not applicable because federal facilities are exempt from this section per 40 CFR 264.140(c) and WAC 173-303-620-(1)(c).

6.5 FINANCIAL ASSURANCE MECHANISM FOR CLOSURE

This section is not applicable because federal facilities are exempt from this section per 40 CFR 264.140(c) and WAC 173-303-620-(1)(c).

6.6 POST-CLOSURE COST ESTIMATE

This section is not applicable because federal facilities are exempt from this section per 40 CFR 264.140(c) and WAC 173-303-620-(1)(c).

6.7 FINANCIAL ASSURANCE MECHANISM FOR POST-CLOSURE CARE

This section is not applicable because federal facilities are exempt from this section per 40 CFR 264.140(c) and WAC 173-303-620-(1)(c).

6.8 LIABILITY REQUIREMENTS

This section is not applicable because federal facilities are exempt from this section per 40 CFR 264.140(c) and WAC 173-303-620-(1)(c).

6.9 REFERENCES

Bone, M. J., and T. J. Schruben, 1984, "Long-Term Stability-Canonsburg, PA. UMTRA Site," in Proceedings of the Sixth Symposium on Uranium Mill Tailings Management, pp. 453-461, Fort Collins, Colorado.

EPA, 1986, Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, Title 40, Code of Federal Regulations, Part 264, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1986, Test Methods for Evaluating Solid Waste, SW-846, U.S. Environmental Protection Agency, Washington, D.C.

Miller, D. E., 1973, "Water Retention and Flow in Layered Soil Profiles," in Field Soil Water Regime, pp. 107-177, Soil Science Society of America Special No. 5, Madison, Wisconsin.

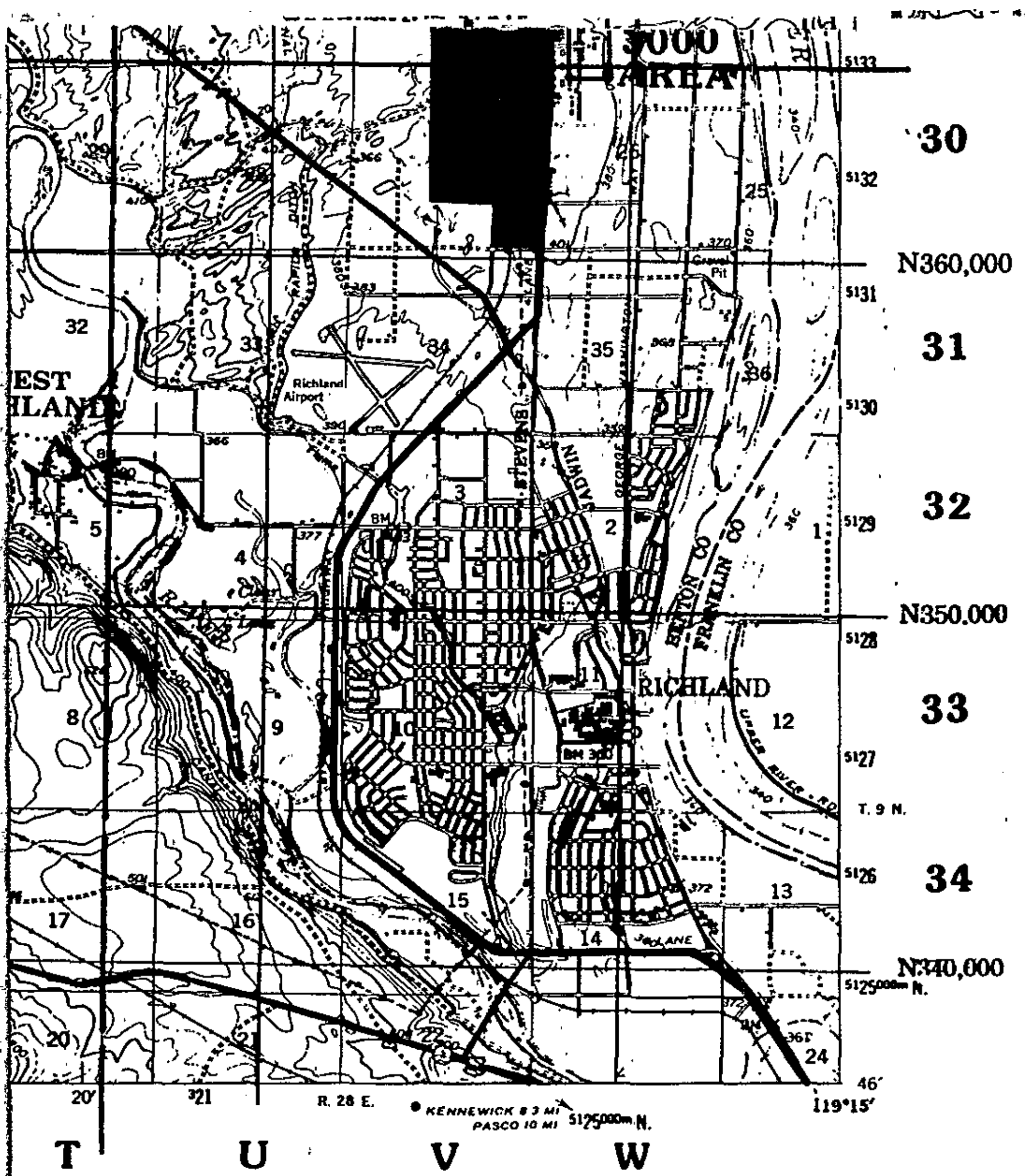
OSHA, 1978, Occupational Safety and Health Standards, Title 29, Code of Federal Regulations, Part 1910, Occupational Safety and Health Administration, Washington, D.C.

Richards, L. A., 1950, "Law of Soil Moisture," Trans. Amer. Geophys. Union, 31 (5).

WAC, 1986, "Dangerous Waste Regulations," Washington Administrative Code, WAC-173-303, Olympia, Washington.

Winograd, I. J., 1981, "Radioactive Waste Disposal in Thick Unsaturated Zones," Science, 212:1457-1464.

APPENDIX A
TOPOGRAPHIC MAP OF THE HANFORD SITE



WING APPROVALS	DATE
OR QUALITY ASSURANCE	
[signature]	1/18/85
SIBLE ENGINEER	
MARTELL	1/18/85
G APPD [signature]	2/8/85
[signature]	1/18/85
[signature]	1/18/85
ICATION NONE	BY NOT REQ'D

U. S. Department of Energy
Richland Operations Office

Rockwell Hanford Operations
Richland, Washington 99352

M

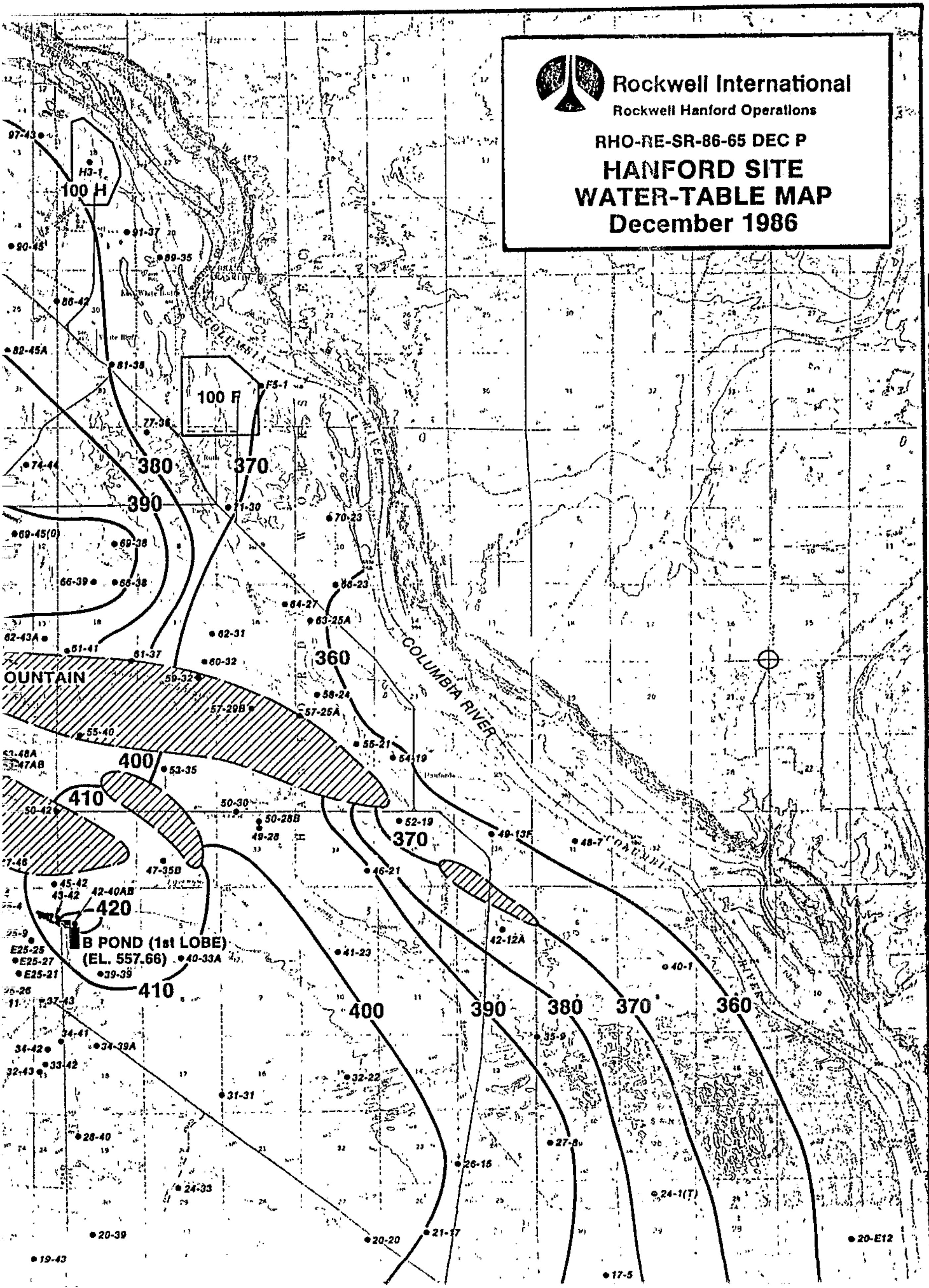
HANFORD SITE MAP

H

SCALE	BLDG NO	INDEX NO.
AS SHOWN	600 GEN	0100

DRAWING NO	SHEET NO.	SHEETS
H-6-951	1	1

APPENDIX B
GROUNDWATER MAP OF THE HANFORD SITE


Rockwell International
Rockwell Hanford Operations
RHO-RE-SR-86-65 DEC P
HANFORD SITE
WATER-TABLE MAP
December 1986
100 H
H3-1
100 F
F5-1
COLUMBIA RIVER
B POND (1st LOBE)
(EL. 557.66)
420
410
400
390
380
370
360
97-43
91-37
90-45
89-35
86-42
82-45A
81-38
77-36
74-44
71-30
70-23
69-45(0)
69-38
66-39
66-38
66-23
64-27
63-25A
62-43A
62-31
61-41
61-37
60-32
59-32
58-24
57-29B
57-25A
55-40
55-21
54-19
53-48A
53-35
52-19
50-42
50-30
50-28B
49-28
49-13F
48-7
47-35B
46-21
45-42
43-42
42-40AB
42-12A
41-23
40-33A
40-1
39-39
37-43
35-9
34-42
34-41
34-39A
33-42
32-43
32-22
31-31
28-40
27-8
26-15
24-33
24-1(T)
21-17
20-E12
20-39
20-20
19-43
17-5
E25-25
E25-27
E25-21

APPENDIX C
LOCATION AND NUMBER OF COPIES OF THE 216-B-63 TRENCH CLOSURE/POST-CLOSURE PLAN

APPENDIX C

LOCATION AND NUMBER OF COPIES OF THE 216-B-63 TRENCH CLOSURE/POST-CLOSURE PLAN

Two copies of the 216-B-63 Trench Closure/Post-Closure Plan are official copies of the plan. These official copies are located at the following office:

U.S. Department of Energy - Richland Operations Office
Federal Building - Room 619
825 Jadwin Avenue
Post Office Box 550
Richland, Washington 99352
(509) 376-7387

APPENDIX D
PERSON RESPONSIBLE FOR STORAGE AND UPDATING OF COPIES OF THE 216-B-63 TRENCH CLOSURE/POST-CLOSURE PLAN

APPENDIX D

PERSON RESPONSIBLE FOR STORAGE AND UPDATING OF COPIES OF THE 216-B-63 TRENCH CLOSURE/POST-CLOSURE PLAN

If a permit modification is requested during the active life of the facility which changes the operating plans or facility design, the 216-B-63 Trench Closure/Post-Closure Plan will be modified at the same time. In all other cases, a request for modification of the 216-B-63 Trench Closure/Post-Closure Plan will be completed within 60 d after a change in operating plans, facility design or events that affect the 216-B-63 Trench Closure/Post-Closure Plan. The following office will be responsible for updating the official copies of the 216-B-63 Trench Closure/Post-Closure Plan.

U.S. Department of Energy - Richland Operation Office
Federal Building - Room 619
825 Jadwin Avenue
Post Office Box 550
Richland, Washington 99352
(509) 376-7387

APPENDIX E
CERTIFICATION OF CLOSURE

APPENDIX E

CERTIFICATION OF CLOSURE

When closure is completed, the U.S. Department of Energy-Richland Operations Office (DOE-RL) will submit to the regulating authority both a self-certification and a certification by an independent registered professional engineer that the 216-B-63 trench has been closed in accordance with the specifications of the approved closure plan.

OWNER/OPERATOR CLOSURE CERTIFICATION

The DOE-RL will self-certify with the following document or a document similar to it:

I, (name), an authorized representative of the U.S. Department of Energy-Richland Operations Office located at the Federal Building, 825 Jadwin Avenue, Richland, Washington, hereby state and certify that the 216-B-63 trench, to the best of my knowledge and belief, has been closed in accordance with the attached approved closure plan, and that the closure was completed on (date). (Signature and date)

PROFESSIONAL ENGINEER CLOSURE CERTIFICATION

The DOE-RL will engage an independent, registered professional engineer to certify that the 216-B-63 trench has been closed in accordance with this approved closure plan. The DOE-RL will require the engineer to sign the following document or a document similar to it:

I, (name), a certified professional engineer, hereby certify, to the best of my knowledge and belief, that I have made visual inspection(s) of the 216-B-63 trench and that closure of the aforementioned facility has been performed in accordance with the attached approved closure plan. (signature, date, state professional engineer license number, business address, and phone number)